

The natural course of fatigue in a working population

Citation for published version (APA):

Janssen, N. (2004). *The natural course of fatigue in a working population*. [Doctoral Thesis, Maastricht University]. Datawyse / Universitaire Pers Maastricht. <https://doi.org/10.26481/dis.20040617nj>

Document status and date:

Published: 01/01/2004

DOI:

[10.26481/dis.20040617nj](https://doi.org/10.26481/dis.20040617nj)

Document Version:

Publisher's PDF, also known as Version of record

Please check the document version of this publication:

- A submitted manuscript is the version of the article upon submission and before peer-review. There can be important differences between the submitted version and the official published version of record. People interested in the research are advised to contact the author for the final version of the publication, or visit the DOI to the publisher's website.
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- The final published version features the final layout of the paper including the volume, issue and page numbers.

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The natural course of fatigue in a working population

Lay-out: BiFab, Bianca Fraats
Cover design: BiFab, Bianca Fraats
Printing: Datawyse, Universitaire Pers Maastricht

ISBN 90-5278411-6
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The natural course of fatigue in a working population

Academisch proefschrift

ter verkrijging van de graad van doctor
aan de Universiteit Maastricht,
op gezag van de Rector Magnificus, Prof. mr. G.P.M.F. Mols,
volgens het besluit van het College van Decanen,
in het openbaar te verdedigen,
op donderdag 17 juni 2004 om 14.00 uur

door

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The Maastricht cohort study is part of the Netherlands concerted research action on 'Fatigue at work', granted by the Netherlands Organization for Scientific Research (NWO). The study presented in this thesis was supported by the Netherlands Organization for Scientific Research, NWO grant no. 580-02.252.

The study presented in this thesis was conducted at the Care and Public Health Research Institute (Caphri), which participates in the Netherlands School of Primary Care Research (CaRe), acknowledged by the Royal Dutch Academy of Science (KNAW).

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1

General introduction

Introduction

In the present thesis, the natural course of fatigue is studied in a working population. Fatigue itself and work characteristics are the predictors that are investigated in this process. Before proceeding to the research questions, some background information is given on the rationale behind the choice to initiate a study on this subject. What is the relevance of a study on the natural course of fatigue in a working population? What is known yet on this subject and, more importantly, what gaps in the knowledge can be identified? Since fatigue in itself is a complicated concept, first some general aspects are described of its definition and measurement. In this way, it becomes clear how the approach of fatigue that is used in the present thesis fits in with the literature on fatigue.

Fatigue

Fatigue is found prevalent in a wide variety of clinical populations (Bombardier & Buchwald, 1995; Chen, 1986; Franssen et al., 2003; Vercoulen et al., 1996; Van der Werf et al., 2002), in the general population (Loge et al., 1998; Pawlikowska et al., 1994), in general practice attenders (David et al., 1990; Hickie et al., 1996; Kroenke et al., 1988) and among employees (Bültmann et al., 2002b). Fatigue manifests itself in differential ways. Fatigue was for example found prevalent as a core symptom of a distinct clinical entity (i.e. the chronic fatigue syndrome), as a symptom accompanying a specific psychological or physical disorder, and/or as a medically unexplained symptom (cf. Piper, 1993; Schaufeli & Houtman, 2000). In the general population, the severity of fatigue is continuously distributed (David et al., 1990; Loge et al., 1998; Pawlikowska et al., 1994; Watt et al., 2000). Fatigue thus occurs in milder forms too and seems to occur in clinical as well as in non-clinical populations. The differential manifestations in which fatigue was found prevalent and the widespread prevalence of fatigue made that fatigue aroused the interest of researchers of many disciplines. However, fatigue is a complex issue (Glaus et al., 1996; Ream & Richardson, 1996; Swain, 2000). Accordingly, the precise definition and measurement of fatigue have been and still are surrounded with confusion (Lewis & Wessely, 1992; Ream & Richardson, 1996; Swain, 2000).

Often mentioned aspects in relation to the definition and measurement of fatigue concern 1) its acute or prolonged nature, 2) its objective or subjective measurement and 3) its multidimensional or unidimensional nature. The terms acute fatigue and tiredness represent a temporary condition (cf. Tiesinga et al., 1996). A condition of acute fatigue can be reversed by compensation mechanisms such as resting or changing the working methods (Meijman & Schaufeli, 1996; Piper, 1989). It has an identifiable cause and can be seen as a 'normal' experience (Ream & Richardson, 1996). The experience of acute fatigue and the accompanying psychophysiological changes can be seen as a functional feedback mechanism in that it warns the individual if that person is confronted with the risk of overstrain or exhaustion (Schaufeli & Houtman, 2000; Van Dijk & Swaen, 2003). In case of prolonged fatigue, compensation mechanisms are no longer effective (Meijman, 1991; Meijman & Schaufeli, 1996; Piper, 1989). Prolonged fatigue is experienced as unusual and disproportionate to or unrelated to activity (Piper, 1993).

The fatigue in itself is problematic, it interferes with the individual's ability to function to his or her normal capacity and it maintains itself in this way (Schaufeli & Houtman, 2000). Hence, prolonged fatigue can have a profound influence on quality of life (Piper, 1993; Ream & Richardson, 1996; Sharpe & Wilks, 2002; Swain, 2000). With regard to the measurement of fatigue, it can be stated that fatigue is mostly described as a nonspecific experience which is dependent upon an individual's perceptions (Glaus et al., 1996; Ream & Richardson, 1996). Hence, the fatigue assessment should best be based on self-report (Meek et al., 2000; Ream & Richardson, 1996). Furthermore, most researchers agree upon that its assessment should incorporate multiple dimensions. The subjective fatigue experience may comprise physical, cognitive, emotional, motivational and behavioural aspects (e.g. Åhsberg, 2000; Piper, 1993; Ream & Richardson, 1996; Schaufeli & Houtman, 2000; Smets et al., 1995; Yoshitake, 1978).

The confusion around the definition and measurement is for example expressed in a wide variety of prevalence rates (Lewis & Wessely, 1992). In general, the confusion led to difficulty in the comparison of study results which in turn led to a lack of integrated knowledge on the comparability of the experience, background and consequences of fatigue across its manifestations (cf. Piper, 1993; Ream & Richardson, 1996; Shapiro, 1998). Some recent studies seem to indicate that different clinical populations, as well as clinical and non-clinical populations should not self-evidently be mixed in the study of fatigue since fatigue may play different roles in different populations. For example, the specific role and meaning of fatigue and its correlates may differ across specific chronic illnesses (cf. Franssen et al., 2003; Glaus et al., 1996). Considering the above, it seems particularly important in studying fatigue to have a clear picture of the research problem and to focus on a particular fatigue manifestation in a particular setting. The focus of the present thesis will become clear in the following paragraphs.

Fatigue in a working population

In the working population, fatigue manifests itself as a core symptom of stress related disorders (Csányi, 1999; Hoogduin et al., 1999; Van Dijk & Swaen, 2003). This concerns a manifestation of prolonged, debilitating fatigue. In the Netherlands, this manifestation has received increasing attention in the last decade. This interest is related to the fact that stress-related disorders (in diagnostic terms called a situational or exogenous reaction) such as burnout, neurasthenia and overstrain are the majority within the group of disability benefit recipients due to mental disorders (Schröer, 1997; Van Eck, 1991; Van Engers, 1995; Veerman et al., 2000). Considering that the prevalence as well as the incidence of the latter group is as high as about 30%, the interest is not surprising (Veerman et al., 1998; Veerman et al., 2000). The prevalence has stabilized in the last decade of the 20th century (Veerman et al., 1998; Veerman et al., 2000). The number of disability benefit recipients due to stress-related disorders is higher in the Netherlands than in other industrialized countries (Veerman et al., 1998). Nevertheless, sickness absence and work disability due to mental health reasons are considered as a problem in other countries such as the United Kingdom too (Glozier, 2002). The severity and chronic character of stress-related disorders are further illustrated by the fact that

employees who are long term sick-listed on mental grounds in the Netherlands have a poor prognosis of return to work (RTW) (Knepper, 1991; Schröer, 1993; Van Engers, 1995). Further, they are more often assessed as work disabled and more often assessed fully disabled in comparison with other diagnosis groups (Veerman et al., 1998; Veerman et al., 2000).

As yet, the exact mechanism behind the cross-sectional relationship between prolonged fatigue and stress-related disorders is poorly understood. This is related to the fact that there appears to be a gap in the study of fatigue between the onset of fatigue and the long term consequences of fatigue. This conclusion is drawn on the basis of the following. First, the present knowledge on fatigue in a working population concentrates on the correlates and the etiology of fatigue (Bültmann, 2002). Work characteristics as well as life-style factors were found predictive for the onset of fatigue (Bültmann et al., 2002a; Bültmann et al., 2002c). On the other side of the gap, two (Dutch) follow-up studies were conducted in employees sick-listed due to stress-related disorders that are important to mention here (Schröer, 1993; Van der Klink et al., submitted). Schröer (1993) found that about 20% of a cohort of 114 employees who were sick-listed for four weeks due to stress-related disorders was assessed work disabled after one year of sickness absence. One of the other outcomes that was studied concerned RTW in the old job during follow-up. This outcome was related to age, job tenure, previous absence behaviour and organisational characteristics. It was notable that work characteristics were not related to the outcome. Van der Klink et al. (2003) conducted an intervention study in 192 employees who were sick-listed due to stress-related disorders. Partial or full RTW at 3 months after onset of sickness absence and time to partial and full RTW were used as outcomes. Predictors of RTW were investigated in the whole study population (intervention plus control group) as well as solely within the intervention group. In univariate analyses, some sociodemographic and some health variables were found significantly related to RTW. However, in multivariate analyses with time to partial RTW as an outcome, no significant results were found other than an effect of the intervention. In multivariate analyses with time to full RTW as an outcome, the predictors intervention, age, educational level and somatisation were found significant. In the above mentioned follow-up studies of employees sick-listed due to stress-related disorders, fatigue was not included as a prognostic factor. Another point of interest relating to these studies concerns the possible influence of response bias on the assessment of the work characteristics. This is because the assessment took place after the onset of the sickness absence. The perception of risk factors may have changed during the process of becoming ill, reporting sick and prolonged sickness absence due to recall bias or due to work-related illness or sickness absence. A third point of interest relating to these studies is that selection effects, for example due to indirect selection of study participants via health professionals or registration systems may have affected the results and the external validity of these results.

Burnout knows a long research tradition in work and organizational psychology. As indicated earlier, burnout is a clinical picture that falls in the category of stress-related disorders. Further, emotional exhaustion is one of the three burnout dimensions and can be described as a measure of work-related, prolonged fatigue. Emotional exhaustion is considered as the core dimension of burnout (Schaufeli et al., 1993). Therefore, the study of burnout may provide important indications on the course of fatigue. Thus far, the study of burnout mainly focused on the etiology of burnout and on the correlates of burnout. Studies on the course of burnout focused on the sequence of the burnout components (e.g. Leiter & Maslach, 1988; Toppinen-Tanner et al., 2002; Van Dierendonck et al., 2001). We do not know of any study in which the prognosis of burnout was studied in a working population within a solely symptomatic group at baseline. Finally, it should be mentioned that results on the natural course of fatigue of earlier reported studies in clinical populations such as patients suffering from the chronic fatigue syndrome, multiple sclerosis or cancer are deliberately not mentioned here. This is primarily because the course of fatigue in clinical populations may differ from the course of fatigue in a (non-clinical) working population (see above).

In summary, there are only a few studies that refer to the course of fatigue or the course of stress-related disorders. Moreover, in the studies on the course of stress-related disorders, the assessment of the work characteristics might have been biased to an unknown degree since these were measured in long-term sick-listed employees. It can therefore be concluded that little is known on the natural course of fatigue at work, that means on the prognosis of fatigue at work and its consequences. Research subjects in the natural course of fatigue at work include the course of fatigue itself, and the relationship between fatigue at work and its possible consequences¹. Specific aim of the present study was therefore to fill this 'gap' in research by increasing the insight in the natural course of fatigue in a working population. This should provide insight in secondary prevention possibilities of more chronic forms of fatigue and other potential negative consequences such as (prolonged) sickness absence.

Filling in the earlier mentioned 'gap' in research on the course of fatigue might have important implications for theory and practice. Starting point for the present thesis is that the nature and strength of predictors in the etiology and in the natural course of fatigue (including fatigue itself as well as its potential consequences as outcomes) might differ. In general, it would be easy and economically advantageous if the same factors would play the same role in both phases of the illness process (i.e. predisposing factors would be the same as maintaining factors). In that case, interventions based on these factors could be applied to risk groups as well as to prevalent cases of a certain condition. Furthermore, health complaints in any stage of the illness process would fade away if the determinants in the etiology would be treated. Unfortunately, this seems a naïve approach (see for example Clark et al., 1995; De Beurs et al., 2000; Weich et al., 1997).

¹ Although the relationship between fatigue and the potential future development of stress-related disorders can also be classified into the subject of the course of fatigue, this subject is not covered by the present study.

Also within the course of health complaints, different predictors may explain the onset and the termination of a sickness absence spell. Accordingly, in the (Dutch) literature, different terms are used for what might be designated as two different stages of the illness process: the first stage is called the sickness absence threshold and the second stage is called the RTW threshold (Philipsen, 1969; Smulders & Veerman, 1990).

Study aim

It can be concluded from the previous two sections that studies on the course of fatigue were not conducted as yet in the working population. Further, studies on the course of stress-related disorders have some methodological disadvantages and do not focus on the course of fatigue. Therefore, the aim of the present study is to investigate the natural course of fatigue in a working population. The natural course of fatigue focuses at how fatigue develops and what the consequences are of fatigue at work. To investigate the course of fatigue in a working population in a methodologically neat way, a prospective study design is needed. A longitudinal study design meets some objections of cross-sectional studies because it includes more than one measurement moment. Therefore, assuming that some methodological conditions are met, longitudinal research enables stronger conclusions on the temporal sequence of relationships (Zapf et al., 1996). Firstly, it is possible to control for previous measurements of the outcome. Thus, spurious relationships at baseline can not explain the longitudinal relationship. Secondly, cause and effect can be clearly split and self-report bias is likely to be (partly) controlled for.

The Maastricht cohort study

In May 1998, as part of a national concerted Priority Research Action on fatigue at work, a large-scale prospective cohort study on fatigue at work was initiated. Employees, coming from 45 companies and organizations, representing different sectors and trades, were invited to participate in a three-year follow-up study (May 1998 – January 2001). In addition, they were asked to give their informed consent to the researchers to collect their sickness absence data via their employer. A total of 12,140 employees agreed to participate². Men and women, aged 18-65 years were included, with a minimum employment of 16 hours per week. Temporary workers were excluded because they may frequently change jobs (Kant et al., 2003). In view of its relationship with stress-related disorders in the working population, the primary outcome was prolonged fatigue. Prolonged fatigue was measured by the 20-item Checklist Individual Strength. This measure comprises several fatigue dimensions (i.e. subjective fatigue, reduction in motivation, reduction in concentration and reduction in activity). Work related as well as non-work related factors (i.e. domestic and social factors, individual characteristics) were

² Though a prospective study design overcomes some methodological drawbacks of cross-sectional studies, the possibility of selective response is a problem that can not be solved. In the present thesis, it is therefore investigated in a separate study to what extent selective response might have affected the results of the Maastricht cohort study. This study is presented in the appendix. In the epilogue, we further reflect upon the potential consequences of the conclusions of this investigation for the results of the present thesis.

included as potential risk factors of the etiology and natural course of fatigue. Next to the primary outcomes fatigue and its consequences (i.e. sickness absence and disability), the secondary health outcomes psychological distress, need for recovery and burnout were included. All of these factors were measured on a yearly basis in an extensive, self-administered questionnaire that was sent to the home address. In addition, twice a year employees received a short, mailed self-administered questionnaire. This short questionnaire mainly included outcome measures and was administered to investigate differential time lags of relationships (Frese & Zapf, 1988).

Next to the mailed self-administered questionnaires, sickness absence data were collected during follow-up by record linkages with organizational sickness absence data. Collecting data on outcome independently of the self-report exposure data shuts out the possibility of response bias (Frese & Zapf, 1988; Vahtera et al., 2000).

In addition, long term sick-listed employees were followed by telephone interviews. Participating companies and organizations provided data on sick-listed employees. Included were employees sick-listed for 6-8 weeks due to health complaints. All diagnoses were included. Pregnant women were excluded. Sick-listed employees were followed until about one year after the onset of the sick leave, which period included the disability assessment by the insurance physician.

Research questions

It can be concluded from the literature review that in broad terms, knowledge is lacking on the stage within the illness process between the occurrence of fatigue and long term absence due to stress-related disorders. The study on the natural course of fatigue can be split in different sub stages. These sub stages are 1) the natural course of fatigue in 'healthy' employees (i.e. those who are not (yet) on long term sickness absence) 2) the transition from fatigue in sickness absence, and 3) (the role of fatigue in) the prolongation of sickness absence and lack of early RTW³. Insight in potential variety in the nature and strength of risk factors across these sub stages increases insight in intervention possibilities in rehabilitation practice.

We investigate the role of work characteristics and fatigue itself as risk factors in the natural course of fatigue. Work characteristics were found to play a role in the etiology of fatigue (Bültmann et al., 2002a) and in the onset and duration of sickness absence (e.g. Smulders & Nijhuis, 1999). Work characteristics may therefore also play an important role in the course of fatigue and in early RTW after long term sickness absence. Considering the fact that the scope of the present thesis is to get insight in the natural course of fatigue, the relationship between work characteristics and early RTW seems at first sight beyond the scope of the present thesis. However, little is known on the relationship between particularly psychosocial work characteristics and (early) RTW (see also Shaw & Polatajko, 2002). It is known that work characteristics are related to fatigue and sickness absence duration (Bültmann et al., 2002a; Bültmann et al., 2002d;

³ A fourth stage concerns the transition from long term sickness absence in work disability due to stress-related disorders. However, this stage is not included in the scope of the present thesis.

Smulders & Nijhuis, 1999). Consequently, work characteristics might affect early RTW and confound the relationship between fatigue and early RTW. Therefore, it was argued that before we can properly investigate the latter relationship, we have to investigate the relationship between work characteristics and early RTW.

Fatigue is explored as a risk factor for sickness absence and RTW after long term sickness absence. Objectively assessed psychological conditions, as well as self-reported mental health were found related with the occurrence and duration of sickness absence. These concerned more severe psychological conditions but also less severe forms of mental health problems (Dremsa et al., 2002; Jenkins, 1985; Savikko et al., 2001; Stansfeld et al., 1995). Further, need for recovery, a measure of acute work-related fatigue, was found to predict long term sickness absence (De Croon et al., 2003). However, the effect of (prolonged) fatigue on sickness absence was not investigated earlier in a structured manner and is therefore explored in the present thesis.

It appears that many health-related variables were also found predictive for RTW (Dasinger et al., 2000; Krause et al., 2001; Russo et al., 1998; Söderman et al., 2003; Van der Giezen et al., 2000). The majority of these studies however did not focus on *early* RTW (Dasinger et al., 2000; Krause et al., 2001), in which only employees with a relatively short time off work are included. Further, few included more than one diagnosis group, and none focused on a multidimensional fatigue measure as predictor of RTW. The study within this thesis on *early* RTW accounted for all of these issues.

A relationship between fatigue and sickness absence and/or RTW is expected, particularly with regard to sickness absence due to stress-related disorders. This expectation originates from the prominent role that fatigue plays in the diagnostic picture of stress-related disorders (see previous sections). Fatigue is generally one of the core complaints (Csányi, 1999; Hoogduin et al., 1999; Terluin & Van der Klink, 1993), and may therefore cause work disability in this diagnosis group. Work disability can be operationalised in terms of the need to report ill or delayed or inability to RTW. The effect of fatigue on early RTW in employees with stress-related disorders is compared with that in other diagnosis groups. It is hypothesized that predictors, and in particular the role of fatigue, may differ across diagnosis groups due to differences in the role of fatigue in the background, etiology and course of specific health complaints.

In line with the above mentioned, we focus in the present thesis on the following research questions:

- a) What is the role of work characteristics in the natural course of fatigue in a 'healthy' working population?

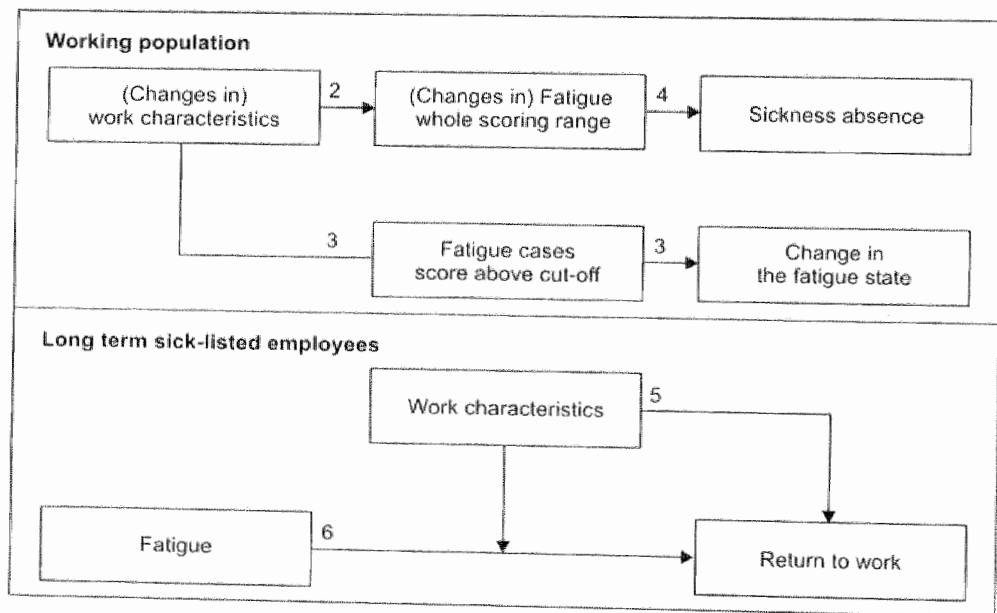
By a 'healthy' working population, we mean an employee population that is still working and not (yet) on sick leave. This subject is investigated in two studies. Firstly, this question is investigated in a population including fatigued and nonfatigued employees. In this particular study, it is investigated to what extent relationships between positive changes in work characteristics and fatigue mirror relationships between positive changes in work characteristics and other mental health complaints. Secondly, this question is investigated in a working population in

which only fatigued employees are included. In contrast with the former study, the second study has a longitudinal design which entails that causes (i.e. work characteristics) and effect (i.e. a change in the fatigue state in fatigued employees) can be clearly separated. Fatigued employees are detected on the basis of a cut-off score on the fatigue scale. Employees scoring above this cut-off point are designated as probable fatigue cases, which puts the employee at risk for sickness absence and disability. The cut-off point was determined in a separate pilot study (Bültmann et al., 2000).

- b) What is the prospective effect of fatigue on short term and long term sickness absence?
- c) What is the effect of work characteristics on early RTW in a population of long term sick-listed employees?
- d) What is the effect of fatigue on early RTW in a population of long term sick-listed employees? This relationship is studied in the whole population, independent of diagnosis, as well as within specific diagnosis categories.

The research questions that are investigated in this thesis, and the corresponding numbers of the chapters, are depicted in figure 1.

Figure 1 Schematic overview of the research questions that were investigated in this thesis and the numbers of the corresponding chapters.



An important work stress model concerns the Demand Control Support model (Johnson & Hall, 1988; Karasek & Theorell, 1990). The operationalizations of the work characteristics as included in this model are widely used and give a rough overview of the work situation. Accordingly, the work characteristics of this model are included in the studies of the present thesis. Only in the second study on the effects of work characteristics on a change in the fatigue state in fatigued employees, a broader selection of work characteristics is investigated. Further, with regard to the research questions 3 and 4 it should be mentioned that early RTW is stated at the moment of four months after the onset of the sick leave. It is known that after this time, the chances to RTW decrease significantly (Lancourt & Kettelhut, 1992) and that the risk of work disability increases accordingly (SVr, 1994).

Outline of the thesis

In **chapter 2**, the associations between positive changes in work characteristics on the one hand and the natural course of fatigue and other mental health complaints on the other hand are described. No restriction was made as regards fatigue scores. Thus, the course of fatigue in fatigued as well as in non-fatigued employees is studied. In **chapter 3**, the results of a three-wave longitudinal study are described. Subject of the study is the effect of work characteristics on a change in the fatigue state. This is explored within a sample of fatigued employees. In **chapter 4**, the consequences of fatigue in terms of sickness absence are addressed. In **chapter 5**, the results are described of a study on the relationship between work characteristics and early RTW. In **chapter 6** is reported on the relationship between fatigue and early RTW in the whole group as well as within diagnosis groups. In **chapter 7**, the epilogue, the findings as described in the present thesis are discussed, the practical implications of these findings as well as recommendations for future study. Finally, in the **appendix**, the results are described of the non-response analysis that is executed within the Maastricht cohort study.

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2

Associations between positive changes in perceived work characteristics and changes in fatigue

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Based on a Dutch publication:

Janssen, N., Nijhuis, F.J.N. (2001). Herstel van langdurige vermoeidheid bij werknemers: de invloed van positieve veranderingen in werkkenmerken [Recovery from long-term fatigue: the influence of positive changes in work characteristics]. *Gedrag en Organisatie*, 14, 273-290.

Journal of Occupational and Environmental Medicine, provisionally accepted

Abstract

Little is known about the natural course of fatigue among employees. An adequate understanding of its development and risk factors is important to prevent chronic health complaints and absenteeism. This longitudinal study investigated associations between positive changes in perceived work characteristics (i.e. a decrease in job demands, an increase in decision latitude and an increase in social support) and changes in fatigue by performing hierarchical regression analyses. The work characteristics of the Demand-Control-Support model were selected as predictors. The outcome measures emotional exhaustion and psychological distress were investigated as secondary outcomes. The results showed that, compared with a stable work situation, positive changes in perceived social support, decision latitude and psychological job demands went together with a decrease in fatigue. Similar results were found for the secondary outcomes emotional exhaustion and psychological distress.

Introduction

Fatigue is a commonly found problem among general practitioner patients (David et al., 1990; Hickie et al., 1996; Kroenke et al., 1988) and in the general population (Chen, 1986; Loge et al., 1998; Pawlikowska et al., 1994). The severity of fatigue follows a continuous distribution (David et al., 1990; Loge et al., 1998; Pawlikowska et al., 1994; Watt et al., 2000; Wessely, 2001). In the literature a distinction is made between acute fatigue and prolonged fatigue (Meijman & Schaufeli, 1996; Piper, 1993; Tiesinga et al., 1996). Acute fatigue is task-specific and tends to disappear after taking some rest. Prolonged fatigue is assumed to be the result of a cumulative process that may occur if the individual is continuously exposed to one or more stressors while there are no or inadequate opportunities to recover (Meijman & Schaufeli, 1996). Prolonged fatigue is not task-specific and compensation mechanisms such as having some rest or switching to different methods of working are ineffective to reverse it at short notice (Piper, 1989). Prolonged fatigue refers to a debilitating state which may have negative effects on the quality of life (Piper, 1993; Ream & Richardson, 1996; Swain, 2000). Another distinction found in the literature is that between explained and unexplained fatigue (Sharpe & Wilks, 2002; Skapinakis et al., 2003; Swain, 2000). If fatigue cannot be explained by a medical condition, the fatigue is referred to as unexplained. Swain (2000) notes that '...in present-day society, significant, prolonged fatigue commonly occurs in the absence of chronic medical illness' (Swain, 2000; cf. Sharpe & Wilks, 2002). A recent study in a working population showed that general, prolonged, unexplained fatigue was a risk factor of sickness absence, particularly long-term sickness absence (Janssen et al., 2003). It will be clear that, practically, high social and economic costs are involved here if one is aware of the fact that about 22% of an employee population could be regarded as (explained and unexplained) fatigue 'cases' in 1998 (Bültmann et al., 2002b). Seen from the perspective of preventing more chronic types of fatigue and sickness absenteeism, therefore, it is important to study the risk factors that may be involved in the course of fatigue at work. In this paper, the subject of study is the course of general, prolonged and unexplained fatigue, that has lasted for two weeks.

Still, little is known about the factors that may affect the course of this fatigue among employees. A well-known work stress model making specific statements about the relation between work characteristics and – the etiology of – health complaints is the Demand-Control (D-C) model (Karasek, 1979), which was later developed into the Demand-Control-Support (DCS) model (Johnson & Hall, 1988; Karasek & Theorell, 1990). The model is based on combined effects of work characteristics. One of the hypotheses in the D-C model is that work situations which are characterized by high job demands and poor decision latitude ('high strain jobs') will have a greater likelihood of developing stress reactions than work situations characterized by low job demands and a great deal of decision latitude ('low strain jobs'). Then the support variable was added to the D-C model: in addition to decision latitude, social support at work was also thought to reduce the negative effects of job demands (Johnson & Hall, 1988; Karasek & Theorell, 1990). The empirical evidence of interaction effects thus far has not been

unambiguous, although direct effects of DCS work characteristics on stress reactions have frequently been demonstrated (De Jonge & Kompier, 1997). A study conducted within the same research framework as the present study demonstrated a strong relation between DCS work characteristics and fatigue (Bültmann et al., 2002d). Although the DCS model primarily predicts the etiology of health complaints, it may also be that its hypotheses can be generalized to include the course of health complaints. Thus, in the present study, positive changes in DCS work characteristics are assumed to be associated with a reduction in health complaints.

The purpose of the study was to examine the relation between positive changes in perceived work characteristics and changes in fatigue. A deliberate choice was made to include two measurements rather than a single measurement of both the independent and dependent variables in the analyses. The difference between both designs is that in the latter cross-sectional design, so-called 'third' variables that were not included in the study design might have unintended effects on the study outcome. In a study design based on intra-individual changes however, the influence of *stable* third variables is eliminated (Frese, 1985; Rodgers, 1989). For this reason, we preferred the latter study design. Still however, the potential disturbing influence of *instable* third variables cannot be ruled out in the present study.

Another observation that can be made about the purpose of this study is that it investigated only the effect of *positive* or *favourable* changes in work characteristics as seen from the DCS model perspective. This decision was based on the high 'face value' of the relation between positive changes in work characteristics and a reduction in fatigue. Another reason to study positive changes only is that positive and negative changes in work characteristics may differ in the power of their effects or in the period of time required before any effects can be measured (cf. Zapf et al., 1996). Trying to find at the same time effects of both positive and negative changes in a single variable thus may lead to biased effect parameters.

The present study's main hypothesis refers to the question whether positive changes in DCS work characteristics (i.e. an increase in decision latitude, a reduction in job demands and an increase in social support) are associated with a reduction in fatigue. A stable work situation (absence of change), on the other hand, is assumed to be associated with fatigue scores that remain unchanged or else with a less substantial reduction in fatigue complaints than is found in case of positive changes in work characteristics. Apart from the main outcome fatigue, two other health measures were included as secondary outcomes, i.e. emotional exhaustion and psychological distress. This was done to get a more complete picture of health developments and to state whether changes in work characteristics have any differential effects on the conceptually different, although highly interrelated, psychological outcome measures (Broadbent, 1985; Warr, 1990). The second hypothesis, therefore, is whether an increase in decision latitude, a reduction in job demands and an increase in social support respectively, are

associated with a reduction in emotional exhaustion and with a reduction in psychological distress.

Methods

The Maastricht cohort study

In 1998 a large scale epidemiological study was started by Maastricht University to investigate fatigue among employees. The Maastricht cohort study is part of a national research programme on 'Fatigue at Work'. The Maastricht cohort study has been designed to establish the prevalence and incidence of fatigue among employees, to identify the risk factors involved in both its etiology and course and to investigate how fatigued employees are treated and supported. The results are meant to produce specific suggestions for prevention measures and policy-making (Kant et al., 2003).

In May 1998 the baseline questionnaire was sent out to a heterogeneous population of nearly 27,000 employees. The respondents came from 45 companies and organisations. All sectors were represented in the study. Once every year the respondents received an extensive questionnaire to measure both risk factors (work, home, personality) and outcome measures (sickness absence, fatigue, secondary health outcomes) in great detail. In addition, a brief questionnaire was sent out to the respondents twice a year to measure only outcome measures in detail. The respondents were followed during a period of three years. At baseline a total of 12,140 respondents participated in the study (a response rate of 45%).

Taris (2000) noted that non-response rates of 30 to 40% are not unusual nowadays. In the Maastricht cohort study, the extensiveness of the baseline questionnaire on work and health, that employees received at the home address, might have put people off from participation in the study. Second, although the study self-evidently was based on voluntary participation, the 3-year follow-up period might have held back potential participants who were asked to fill out a total of 9 questionnaires. Third, the fact that potential participants were asked to give their written informed consent for participation, which included the collection of their sickness absence data on the basis of organizational records, might have held them back from participation. A non-response analysis revealed that, in comparison with respondents, baseline non-respondents reported less often having experienced fatigue complaints or having been sick-listed in the last four months at the time of the baseline measurement. Further, non-respondents worked less hours per week. No differences were found between respondents and non-respondents regarding subjective general health, gender, age and education. Since variety in fatigue and other characteristics in cohort participants was still guaranteed, it was concluded that it is not likely that explanatory analyses are affected by selection bias to a great extent.

Two extensive measurements were used in the present study, i.e. the baseline measurement (T_0) and the extensive measurement one year later (T_3). Since one-year

follow-ups are frequently applied in occupational-psychological studies (Zapf et al., 1996), it will be easy to compare results; in addition, seasonal effects are neutralized by administering follow-up measurements during the same time of year (Schaufeli & Enzmann, 1998). At T_3 , i.e. one year after T_0 , a total of 9655 respondents completed the questionnaire (79.5% of the initial number of respondents). A comparison between the respondents who participated at T_0 only and those who participated at both T_0 and T_3 showed that young and lower educated employees who reported a relatively poor fatigue state at baseline had discontinued participation at T_3 (Kant et al., 2003).

Study population

People suffering from long term physical and psychiatric illnesses were excluded from the analyses. They were those who made explicit mention of suffering from a long term illness at T_0 and/or T_3 and/or who marked one of the illnesses (e.g. asthma, cancer, psychiatric condition) specified in the follow-up question (T_0+T_3 : $n = 4058$). Pregnant women were also excluded from the analyses (T_0+T_3 : $n = 181$). These two categories are likely to perceive fatigue, and possibly their work situation as well, differently from 'healthy' employees. Also, due to other factors such as medication, their physical condition may affect both the level of their fatigue scores and their fatigue development in ways that are not found among other employees. Finally, the study population did not include employees who were sick-listed for more than one month at the time of administering the questionnaire (T_0+T_3 : $n = 468$). This was done because they might have distorted views of their work situation due to long term sickness absence or because of work related sickness absence. The implication of the applied exclusion criteria and panel design is that a large group of workers was excluded in advance; however, a more accurate assessment of the relation between health and work can be achieved if disturbing external influences are removed. After applying the exclusion criteria 6108 respondents were left. The study involved a panel group with a follow-up of one year who did not have any missing values on the study variables at both T_0 and T_3 . As a result, the final study population included 5256 employees. A Pearson correlation analysis showed that the correlations between the study variables for the group of those who did not have any missing values ($n = 5256$) hardly differed, if at all, from the correlations found when respondents with missing values were also included ($n = 6108$). Thus, excluding respondents with missing values did not seem to have any effect on the relations between the study variables.

Measures

Outcome measures

Fatigue. Fatigue was measured by using the Checklist Individual Strength (CIS), a 20-item questionnaire. Respondents indicated on a 7-point Likert scale how they generally felt during the past two weeks. The questionnaire has four subscales: subjective fatigue (eight items); reduction in motivation (four items); reduction in activity (three items); reduction in concentration (five items). Adding the four subscales leads to scores ranging from 20 to 140. Higher scores imply a higher degree of fatigue. The CIS was tested extensively in clinical settings (Vercoulen et al., 1994; Vercoulen et al., 1999) and it was

validated in a pilot study (Beurskens et al., 2000). Cronbach's alpha ($n = 5256$) was .93 at T_0 and .94 at T_3 .

Emotional exhaustion. Emotional exhaustion was assessed with the Dutch version of the Maslach Burnout Inventory-General Survey (MBI-GS; Maslach & Jackson, 1986; Schaufeli & Van Dierendonck, 2000). The emotional exhaustion scale has five items which all refer specifically to the work situation. Items are scored on a 7-point frequency scale. Scale scores vary between 0 and 6. Higher scores imply a higher degree of emotional exhaustion. Cronbach's alpha ($n = 5256$) was .87 at T_0 and .89 at T_3 .

Psychological distress. Psychological distress was measured by using a Dutch translation of the General Health Questionnaire (GHQ-12; Goldberg & Williams, 1988; Koeter & Ormel, 1991). Originally, the GHQ was developed to measure mild, non-psychotic psychiatric diseases within the general population. The list covers elements such as fear, chronic stress and depression. Respondents are asked to identify which complaints they had during the past few weeks. Items are scored on a 4-point scale. In this study the Likert scoring method was applied (0,1,2,3). As a result, the continuous total score for the 12 items ranged from 0 to 36. Higher scores imply higher levels of psychological distress. Cronbach's alpha ($n = 5256$) was .86 at both T_0 and T_3 .

Work characteristics

Decision latitude. The concept of decision latitude is a combination of two concepts: the amount of skill used in executing tasks (skill opportunities) and decision authority, i.e. discretion in planning and executing tasks and in taking decisions (decision-making opportunities) (De Jonge et al., 1993). The entire decision latitude scale consists of nine items. Its score ranges from 24 to 96. Cronbach's alpha ($n = 5256$) was .81 at T_0 and .82 at T_3 .

Psychological job demands. The scale of job demands has five items. Its range varies from 12 to 48. Cronbach's alpha ($n = 5256$) was .69 at both T_0 and T_3 .

Social support. The social support scale measures support from colleagues (four items) and support from managerial staff (four items). The items measure both socio-emotional and instrumental support. Its range varies between 8 and 32. Cronbach's alpha ($n = 5256$) was .78 at T_0 and .79 at T_3 .

Work characteristics were measured by using a validated Dutch translation of the Job Content Questionnaire (JCQ; Houtman, 1995; Karasek, 1985). Items are scored on a 4-point scale ('totally disagree' to 'totally agree'). Higher scale scores imply higher levels of decision latitude, job demands and social support, respectively.

Statistical analysis

Differential scores

Change scores were calculated by standardizing the cross-sectional work characteristics at T_0 and T_3 . This was done by subtracting the population mean of the score and dividing this subtracted score by the standard deviation. The standardized scores on the work characteristics at T_0 and T_3 were then mutually subtracted (Rodgers, 1989). Standardization will prevent that changes are also determined by general changes in work characteristics. Furthermore, centring predictors may reduce collinearity between

independent variables in regression analyses (Kleinbaum et al., 1998). For decision latitude and social support, negative differential scores (below zero) implied positive change in one of the work characteristics, i.e. increased decision latitude and increased social support. For the job demands variable, positive differential scores (above zero) implied a positive change in job demands, i.e. a reduction of job demands. Higher absolute differential scores generally implied more positive change; lower differential scores (approaching zero) implied marginal positive change, which may be considered as approximately equalling a stable work situation.

Univariate analyses

To improve our understanding of the data, several univariate analyses were carried out before conducting major multivariate analyses. Paired T-tests were performed to examine any significant score developments on the study variables between T_0 and T_3 . Also, Pearson correlation coefficients were calculated for the study variables.

Multivariate analyses

The relations between positive changes in work characteristics and changes in outcomes were investigated by using hierarchical regression analyses. The first step in the regressions was to control for the covariates of age, level of education (dummies), gender (dummy) and a previous cross-sectional measure of the dependent variable involved (Finkel, 1995; Zapf et al., 1996). The static scores were associated quite strongly with the change scores. In order to distinguish between the effects of the two predictors, therefore, the second step was to add as covariates the static work characteristics at T_0 . The third step was to control for changes in the 'other two' work characteristics (depending on the work characteristic being the focus of attention in step four). Step three made use of the total range of positive and negative differential scores, partly because these factors were included in the analyses as covariates only, partly because the study population would be seriously reduced if selection was based exclusively on positive changes found in *all three* work characteristics. The focus of analysis is step four, which was designed to identify the effect of positive change – as seen from the perspective of the DCS model – in one of the work characteristics (increased decision latitude, increased social support and decreased job demands). It is emphasized that the effect of a positive change was established independently of either positive or negative changes in the other work characteristics as they were controlled in step three.

The focus on positive change implied that, beforehand, a sample was selected which was subject to some positive change in one of its work characteristics (i.e. the selection was based on getting a continuum from no change to maximum positive change). The result of the selection was that the three analyses for separate work characteristics focussing on a positive change in job demands, decision latitude or social support respectively differed in the size of their subsamples.

Results

Univariate analyses

The scores on work characteristics and health characteristics are reported in Table 1. At T_3 , lower levels of job demands, social support and decision latitude were reported as compared to T_0 . However, the means and standard deviations make it clear that differences were only marginal, probably reaching significance due to the great number of respondents. As was mentioned earlier, general changes in mean group scores on work characteristics did not affect results as differential scores were not calculated until after standardization.

In order to make valid statements the correlations between (static) work characteristics and (static) outcome measures should be similar at T_0 and T_3 . This appeared to be the case (results not shown).

Table 1 Means (M), standard deviations (SD) and paired T tests for the study variables ($n = 5256$).

Variable	T_0		T_3		T-test
	M	SD	M	SD	<i>t</i>
Fatigue	52.13	21.36	52.27	21.78	-.61
Emotional exhaustion	1.62	1.04	1.60	1.06	1.27
Psychological distress	10.64	4.41	10.73	4.41	-1.37
Social support	22.56	3.01	22.48	2.96	2.09*
Job demands	33.00	5.56	32.56	5.48	6.50***
Decision latitude	73.31	10.89	73.02	10.49	2.49*

T_0 refers to the measurement taken late May '98;

T_3 refers to the measurement one year later, late May '99.

* $p < .05$; *** $p < .001$

The correlations between the study variables are reported in Table 2. First, the results show that test-retest correlations were rather low for psychological distress ($r = .43^{**}$) as compared to emotional exhaustion ($r = .72^{**}$) and fatigue ($r = .68^{**}$).

Second, static scores and changes in those scores appeared to be fairly strongly associated ($r = .47^{**}$ for social support, $r = .45^{**}$ for job demands and $r = .40^{**}$ for decision latitude). Unfavourable scores on specific work characteristics were associated with more positive change in those work characteristics. For example, lower scores on social support at T_0 (little perceived social support) were associated with increased social support between T_0 and T_3 . It is not strange to find this correlation; after all, the change scores are based on the static scores on work characteristics and ceiling effects probably influenced the results. The correlations involved did not seem to be strong enough to expect statistical problems as a result of overly strong associations between static scores and change scores if both types of predictors were included in the regression model.

Table 2 Pearson correlations of the variables under study (n=5256).

Variables	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1 Fatigue T_0	-													
2 Emotional exhaustion T_0	.68**	-												
3 Psychological distress T_0	.59**	.51**	-											
4 Social support at work T_0	-.24**	-.24**	-.25**	-										
5 Job demands T_0	.17**	.35**	.22**	-.17**	-									
6 Decision latitude T_0	-.21**	-.17**	-.16**	.32**	.08**	-								
7 Age	-.01	-.01	.04**	-.11**	.04**	.08**	-							
8 Educational level	.00	-.02	.02	.07**	.05**	.33**	-.05**	-						
9 Gender	.02	.03*	-.02	-.10**	.07**	.14**	.19**	-.01	-					
10 Fatigue T_3	.68**	.55**	.43**	-.19**	.14**	-.17**	.02	-.02	.05**	-				
11 Emotional exhaustion T_3	.56**	.72**	.41**	-.19**	.28**	-.14**	-.01	-.03	.03*	.70**	-			
12 Psychological distress T_3	.36**	.33*	.43**	-.14**	.16**	-.08**	.05**	.02	.01	.57**	.50**	-		
13 Difference social support at work	-.02	-.04**	-.06**	.47**	-.04**	.11**	.02	-.03*	.01	.07**	.06**	.08**	-	
14 Difference job demands	.02	.06**	.06**	-.08**	.45**	-.01	.04**	-.05**	-.01	-.07**	-.11*	-.08**	-.11**	-
15 Difference decision latitude	-.02	-.03*	-.02	.09**	.01	.40**	.04**	.00	.03*	.08**	.05**	.11**	.28**	.01

Note: * $p < .05$; ** $p < .01$; gender was coded 0=female, 1=male.

Educational level coded as 1=low, 2=medium, 3=high. Differential scores of the work characteristics include negative as well as positive changes. A negative differential score (below zero) implied for the variables 'difference in social support at work' and 'difference in decision latitude' a positive change in these variables (i.e. increased support and decision latitude), whereas a positive differential score (above zero) implied for the variable 'difference in job demands' a positive change (i.e. decreased job demands).

Third, the correlations between the change scores reported in Table 2 reveal that an increase in decision latitude was associated with an increase in social support ($r = .28^{**}$). A decrease in job demands was slightly associated with an increase in social support ($r = -.11^{**}$). Changes in decision latitude and changes in job demands were unrelated ($r = .01$).

Fourth, fatigue and emotional exhaustion were strongly related (T_0 : $r = .68^{**}$; T_3 : $r = .70^{**}$) and correlations between psychological distress and fatigue were also quite high (T_0 : $r = .59^{**}$; T_3 : $r = .57^{**}$). The correlations between psychological distress and emotional exhaustion were $.51^{**}$ at T_0 and $.50^{**}$ at T_3 .

Table 3 Hierarchical regression analyses in four steps, in a population displaying between maximum positive change in decision latitude and no change at all, for the relation between positive change in decision latitude and the dependent variables of fatigue, emotional exhaustion and psychological distress, respectively (n = 2790).

Step	Variable	Fatigue		Exhaustion		Distress	
		ΔR^2	β	ΔR^2	β	ΔR^2	β
1.	Gender	.45***	.03*	.51***	-.01	.16***	.00
	Education low (reference)						
	Education medium		.01		-.02		.03
	Education high		.02		.00		.02
	Age		.03		.00		.03
2.	Fatigue/Exhaustion/Distress*		.64***		.68***		.37***
	Decision latitude	.00**	-.10***	.00*	-.05**	.01**	-.09***
	Job demands		.09***		.14***		.16***
	Social support		-.04*		-.03		-.05*
3.	Difference job demands	.02***	-.12***	.04***	-.20***	.04***	-.18***
	Difference social support		.08***		.07***		.10***
4.	Difference decision latitude	.01***	.10***	.00***	.07***	.01***	.13***
R^2		.48***		.56***		.22***	

Note: Gender was coded as 0 = female (reference), 1 = male; two dummies were included in the regression equations for education, i.e. medium level of education and high level of education, using low educational level as reference category.

* $p < .05$; ** $p < .01$; *** $p < .001$.

* Fatigue/Emotional exhaustion/Psychological distress were added as covariates in the first, second and third columns, respectively.

Multivariate analyses

Tables 3, 4 and 5 present the results of hierarchical regression analyses. The standardized beta (β) values of the end model are presented; for the individual steps made in the regression analyses the additional amount of variance explained (ΔR^2) is given. The results show that all the regression models had significant F tests; all the predictors combined made a significant contribution to the amount of variance to be explained in the three outcome measures. The relatively high amount of total variance

explained and the differences in total explained variance between the outcome measures were produced mainly because an earlier measurement of the dependent variable was included in the analyses (see also the test-retest correlations of the outcome variables).

Table 4 Hierarchical regression analyses in four steps, in a population displaying between maximum positive change in job demands and no change at all, for the relation between positive change in job demands and the dependent variables of fatigue, emotional exhaustion and psychological distress, respectively (n = 2378).

Step	Variable	Fatigue		Exhaustion		Distress	
		ΔR^2	β	ΔR^2	β	ΔR^2	β
1.	Gender	.45***	.04*	.52***	.03	.16***	.00
	Education low (reference)						
	Education medium		.00		-.02		.03
	Education high		.02		.01		.07*
	Age		.02		.03*		.06**
	Fatigue/Exhaustion/Distress [‡]		.64***		.68***		.35***
2.	Decision latitude	.00	-.10***	.00**	-.07***	.01***	-.09***
	Job demands		.06***		.11***		.14***
	Social support		-.04*		-.04*		-.09***
3.	Difference social support	.02***	.09***	.01***	.08***	.03***	.11***
	Difference decision latitude		.11***		.04*		.13***
4.	Difference job demands	.01***	-.09***	.02***	-.16***	.01***	-.08***
	R^2	.48***		.55***		.22***	

Note: Gender was coded as 0 = female (reference), 1 = male; two dummies were included in the regression equations for education, i.e. medium level of education and high level of education, using low educational level as reference category.

* $p < .05$; ** $p < .01$; *** $p < .001$.

[‡] Fatigue/Emotional exhaustion/Psychological distress were added as covariates in the first, second and third columns, respectively.

Women appeared to be more likely to have reduced fatigue scores one year later as compared to men. Demographic variables did not have any consistent effects on emotional exhaustion or psychological distress (tables 3, 4 and 5).

The multivariate regression analyses (step 4) showed that decreased job demands, increased decision latitude and increased support resulted in significantly more reduced fatigue scores as compared to a situation which did not include any changes in work characteristics. Similar results were found for the effects of positive changes on the outcome measures of psychological distress and emotional exhaustion. Remarkably, the emotional exhaustion reaction was particularly positive when a decrease in psychological job demands was involved as compared to the reaction of emotional exhaustion to

changes in the other work characteristics. The latter effect can also be said to be great as compared to the relationship between a decrease in job demands and a reduction in fatigue or psychological distress.

Table 5 Hierarchical regression analyses in four steps, in a population displaying between maximum positive change in social support and no change at all, for the relation between positive change in social support and the dependent variables of fatigue, emotional exhaustion and psychological distress, respectively (n = 3180).

Step	Variable	Fatigue		Exhaustion		Distress	
		ΔR^2	β	ΔR^2	β	ΔR^2	β
1.	Gender	.47***	.03*	.54***	-.01	.18***	.00
	Education low (reference)						
	Education medium		.02		-.01		.06*
	Education high		.02		-.01		.07**
	Age		.02		-.01		.04**
	Fatigue/Exhaustion/Distress [*]		.65***		.70***		.38***
2.	Decision latitude	.00*	-.08***	.00	-.05**	.00**	-.09***
	Job demands		.09***		.13***		.14***
	Social support		-.04*		-.04**		-.05**
3.	Difference job demands	.02***	-.12***	.04***	-.21***	.04***	-.16***
	Difference decision latitude		.09***		.06***		.12***
4.	Difference social support	.00***	.08***	.00***	.07***	.01***	.08***
	R^2	.50***		.58***		.22***	

Note: Gender was coded as 0 = female (reference), 1 = male; two dummies were included in the regression equations for education, i.e. medium level of education and high level of education, using low educational level as reference category.

* $p < .05$; ** $p < .01$; *** $p < .001$.

* Fatigue/Emotional exhaustion/Psychological distress were added as covariates in the first, second and third columns, respectively.

The effect of positive changes in work characteristics was examined independently of the initial values of work characteristics. The contributions made by the static scores continued to be significant in the end model. The direction of the effects of the static scores on DCS work characteristics proved to conform to the relevant hypotheses postulated by the DCS model: low levels of decision latitude, high job demands and low levels of social support predicted higher levels of fatigue than did high levels of decision latitude, low job demands and high levels of social support. It can be deduced from the tables 3, 4 and 5 that of the DCS work characteristics, generally, the static job demands variable had the strongest effect on the outcome measures.

Discussion

The hypothesis that positive changes in work characteristics are associated with a decrease in fatigue was confirmed. The hypothesis that these positive changes in work characteristics were also associated with decreases in emotional exhaustion and psychological distress, was confirmed as well. The effects of the changes in the work characteristics were stated independently of their baseline level. Thus, an association between changes in work characteristics and changes in fatigue was observed over and above of the effect of the baseline levels of the work characteristics on a future change in fatigue. Hence, this study revealed a complex interrelationship between levels of work characteristics and changes in work characteristics on the one hand, and changes in fatigue (and related mental health complaints) on the other hand. The results might point at a bi-directional relationship.

High correlations were found between the outcome measures (particularly between fatigue and emotional exhaustion). In combination with the homogeneity of the effects of the changes in the work characteristics on the outcomes, the question can be raised if the effects found for specific outcome measures were affected by this strong association. Additional control in the analyses for the other outcome measures, however, did not affect the conclusions. Further, there is some evidence that fatigue and psychological distress represent different constructs (Bültmann et al., 2002b).

Fatigue and emotional exhaustion appeared to be outcome measures that were relatively stable in time, even though the study applied rather severe exclusion criteria which prevented for example employees suffering from long term illnesses from being included in the study population. Thus, on an individual level, fatigue and emotional exhaustion are quite persistent phenomena, even among a – healthy – population of workers. These results are in agreement with the conclusions drawn by Schaufeli and Enzmann (1998), which were based on a number of studies reporting the stability of emotional exhaustion. They concluded that this stability 'is quite high for a construct that is believed to be affected by current situational conditions' (Schaufeli & Enzmann, 1998). Based on the results of the present study, this conclusion also seems to be justified for fatigue. Psychological distress proved to be far less stable. This is in agreement with the conclusion drawn by Lovibond (1998), based partly on his own research efforts (using instruments similar to the GHQ), that emotional syndromes are quite variable in time (Lovibond, 1998). Related to the stability of the outcome measures, the baseline measurements of the outcome measures of fatigue and emotional exhaustion were found to have a rather dominant influence within the regression model. Still, in spite of this dominating influence, the positive changes in work characteristics were found to go together with a reduction in fatigue and emotional exhaustion.

Reduction in job demands had a particularly positive effect on the level of emotional exhaustion (see also Lee & Ashforth, 1996; Schaufeli & Enzmann, 1998). Referring to psychological health complaints, Karasek et al. (1998) stated that of the DCS work characteristics, job demands were especially associated with fatigue and burnout

(Karasek et al., 1998). If this proposition is assumed to apply also to *positive changes* in job demands then this is confirmed by the relatively strong association between reduction in job demands and decrease in emotional exhaustion. The proposition did not hold for fatigue; fatigue displayed about equally strong reactions to all three changes in work characteristics investigated.

There are two previous studies that investigated effects of intra-individual changes in the DCS work characteristics in a similar way as was done in the present study. In a study among clerical workers, a reduction in job demands was found to be associated with decreasing need for recovery (Furda et al., 1994). In another study in a population of nursing and care staff, associations were found between increasing supervisor social support and decreasing job demands, on the one hand, and decreased emotional exhaustion, on the other (De Jonge et al., 1998). Possibly, subtle differences in study design (e.g. analyses, operationalisations) are connected with the fact that the present study did find effects of positive changes in *all three* DCS work characteristics on fatigue and related mental health complaints. Moreover, the above-mentioned studies referred to specific occupational groups.

Study limitations

First, using questionnaires – and only questionnaires – may have affected the power of relations as a result of self-report bias due to common variance of methods, cognitive consistency, social desirability, overlap between dependent and independent variables, et cetera (e.g. Algera, 1992). In this respect it should be observed, however, that the study made exclusive use of measuring instruments that were thoroughly validated (Beurskens et al., 2000; Karasek et al., 1998). Karasek et al. (1998) also stated on this point that the JCQ items (Karasek, 1985; Houtman, 1995) were phrased as objectively as possible, focussing on reporting rather than on a cognitive assessment of work characteristics. Apart from self-report bias, (other) third variables that were not included in the study may also have affected the power of the relations investigated (Finkel, 1995; Zapf et al., 1996). However, stable third variables such as negative affectivity (Karasek et al., 1998; Parkes, 1994;) hardly played a role in the present study since it focussed on the effects of intra-individual changes (Rodgers, 1989).

Second, changes in the work situation were operationalized as positive changes in perceived work characteristics. Clearer indications on the practical implications of the present study would have been present if supplementary, independent ratings of changes in work characteristics would have been assessed and linked to the self-report data on fatigue and secondary health outcomes (Kristensen, 1996). It is however impossible to obtain these supplementary, independent ratings on all participants in a large-scale study such as the Maastricht cohort study (Kant et al., 2003). The exclusive reliance on self-report data entails that it remains unclear whether the changes in the perceived work characteristics reflect objective changes in work characteristics or whether measured changes primarily reflect changes in work attitude. Thus, based on the present study, it is impossible to say whether work-oriented interventions ('job

redesign'; Karasek & Theorell, 1990) or individual-oriented interventions (e.g. cognitive behaviour therapy) are effective in reducing fatigue and related mental health complaints. As for individual-oriented interventions, for example, it was demonstrated that, in a population of employees suffering from burn-out symptoms, a changed perception of the work situation was sufficient to have a positive and long term effect on psychological health or absenteeism, even if this was not accompanied by actual changes in work characteristics (Van Dierendonck et al., 1998). To obtain more clarity on this subject, a (quasi)experimental research could be initiated on the basis of the present study results. In this research, the relationships between objective and subjective changes in work characteristics and changes in fatigue could be further explored.

Third, although a longitudinal design was applied, it was not possible to draw conclusions about cause-and-effect relations. This is because measurement of the independent variables (i.e. changes in work characteristics) did not precede measurement of the outcome measures (Finkel, 1995). As already stated, theoretically, relations are possible in both directions (e.g. Schaufeli & Enzmann, 1998; Zapf et al., 1996). Positive changes in work characteristics may lead to working conditions that involve fewer health hazards while offering more opportunities to recover during task performance, resulting in reduced fatigue. Alternatively, it is possible that high fatigue causes employees to entertain - more - negative views about the work place. Furthermore, it is also possible that employees suffering from lower levels of fatigue will be better able to adjust the objective work situation so as to meet their wishes or else will be offered more promotion opportunities so that they will perceive greater positive – objective – changes in their work than fatigued workers (cf. De Jonge et al., 2001; Taris et al., 1998; Zapf et al., 1996). In a longitudinal study, for example, it was found that depressed workers changed jobs and got promotion less frequently (Taris et al., 1998). Moreover, depressed workers who changed jobs appeared to experience smaller positive effects as a result of changing jobs in terms of improved work characteristics than did workers with less depressed feelings who changed jobs.

A fourth limitation of the present study is that it focussed on DCS work characteristics. Several authors have criticized the conceptualisation and operationalisation of DCS work characteristics (e.g. De Jonge & Kompier, 1997). Measuring instruments were said to overlap in terms of conceptualisation. Furthermore, other work characteristics might also play some role in the etiology and course of health complaints (De Jonge & Kompier, 1997). Future studies investigating the course of fatigue might improve our understanding of the effects of more differentiated measures of work characteristics such as different types of support and other sorts of job demands such as physical job demands and emotional job demands.

Fifth, even though sufficient variety in exposure and outcomes appeared still present, a final, more general limitation of the present study is that it cannot be ruled out that selective initial and follow-up non-response (see methods section) have affected the results of the present study.

Sixth, significant relationships were established between positive changes in work characteristics and changes in fatigue and related mental health complaints. However, the amount of additional explained variance for individual positive changes (i.e. the last step in the separate hierarchical regression models) was very low; it varied between 0 and 2%. It is therefore likely that, next to work characteristics, other factors play a role in the course of fatigue and related mental health complaints. Intervening in a combination of several sorts of predictors might then be more effective than solely in work characteristics.

Overall conclusion

The complex relationships that were found between positive changes in work characteristics on the one hand and changes in fatigue, emotional exhaustion and psychological distress on the other hand, emphasizes the complexity of the course of fatigue as a subject of study. The course of fatigue among workers is still relatively virgin territory and requires additional study.

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3

Work-related risk factors in the natural course of fatigue: Prospective results from the Maastricht cohort study on fatigue at work

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Abstract

The aim of this three-wave panel study was to investigate the work-related determinants of a change in the fatigue state. In a heterogeneous population of 660 fatigued employees, effects of levels of work characteristics and of changes in work characteristics were studied. Fatigue was operationalized by four dimensions: subjective fatigue, reduction in motivation, reduction in concentration and reduction in activity. Analyses were performed using structural equation modeling. A decrease in psychological job demands predicted an increase in activity. Further, the level of co-worker support, decision authority and psychological job demands had differential effects on a change in the four fatigue dimensions. The data also revealed that for some of these work characteristics not only the level but also a change in the concerning variable would probably lead to a change in the fatigue state. Consequently, it was concluded that interventions in fatigued employees should focus on a decrease in job demands to induce a positive change in all fatigue dimensions, and on an increase in decision authority to induce a positive change in motivation. The other relationships between levels of work characteristics and a change in the fatigue state could probably be attributed to third variables.

Introduction

Fatigue is a common complaint (Bültmann et al., 2002b; Chen, 1986; David et al., 1990; Hickie et al., 1996; Kroenke et al., 1988; Loge et al., 1998; Pawlikowska et al., 1994). It was found prevalent in differential manifestations. For example, it accompanies physical and psychological long-term diseases (Chen, 1986). In the working population, fatigue is an important symptom of stress-related disorders such as chronic job stress and burnout (Van Dijk & Swaen, 2003; Schaufeli & Enzmann, 1998; Terluin & Van der Klink, 1993). These concern manifestations of prolonged fatigue, which should be distinguished from acute fatigue or tiredness. The latter represent a temporary condition (cf. Ream & Richardson, 1996; Tiesinga et al., 1996). A condition of acute fatigue can be reversed by compensation mechanisms such as resting or changing the working methods. In case of prolonged fatigue, compensation mechanisms are no longer effective (Meijman, 1991; Meijman & Schaufeli, 1996; Schaufeli & Houtman, 2000). Prolonged fatigue interferes with the individual's ability to function to their normal capacity and it therefore can have a strong impact on the quality of life (Piper, 1993).

As yet, the mechanism behind the relationship between fatigue¹ and stress-related disorders among employees is poorly understood. It might be that fatigue at work plays a role in the development of stress-related disorders in the long term. This, and the fact that fatigue was found to be an important risk factor of short-term and long-term sickness absence (Janssen et al., 2003), underline the importance to gain insight in the aetiology and natural course of fatigue. A recent longitudinal study revealed that work-related factors play an important role in the aetiology of fatigue (Bültmann et al., 2002a). Thus far however, little is known on the role of work characteristics in the course of fatigue. Though the aetiology and course of fatigue are connecting phases in the illness process, risk factors may differ in strength and nature between both phases (cf. De Beurs et al., 2000; Zapf et al., 1996). Therefore, the present study focuses at the work-related determinants in the natural course of fatigue in a working population.

Effects of levels of work characteristics and effects of changes in work characteristics were investigated. In the majority of self-report studies on work and health, it was only investigated whether the level of a work characteristic at a particular point in time was related to health at the same time (in case of cross-sectional studies) or at a later point in time (in case of a two-wave study) (cf. Zapf et al., 1996). The exclusive investigation of levels of work characteristics means that the within-subject, causal nature of the relationship is ambiguous. This is because the found relationship may be attributed to third variables (i.e. subject-specific characteristics), which were not included in the research model (cf. Frese, 1985). Examples of third variables are social desirability, socio-economic status and personality (e.g. Dormann & Zapf, 2002; Frese, 1985; Frese

¹ In the rest of this paper we use the term 'fatigue' instead of 'prolonged fatigue' since in most literature the term fatigue refers to long-term or prolonged fatigue. Further, the adjectives long-term and prolonged may only lead to confusion around their specific meanings.

& Zapf, 1988; Zapf et al., 1996). Consequently, conclusions on the effectiveness of *interventions* in work characteristics are ambiguous in these studies with exclusively levels of work characteristics. These objections are partially met by the investigation of within-subject *changes* in work characteristics as predictors, which are then preferably linked to future changes in the outcome measure. If changes in work characteristics are assessed by the subtraction of two measurements of the same variable, then relationships between within-subject changes are not affected by *stable* third variables. This is because these affect the two measurements on which the subtraction is based equally (Rodgers, 1989).

Notwithstanding the above, it seems useful to study levels of work characteristics next to changes in work characteristics. The study of (only) levels of work characteristics seems useful in exploratory studies by increasing the global insight in work stress processes and by helping to identify risk groups for an adverse health state. Further, the dissimilar measurement of levels and changes in work characteristics leads to different interpretations of their effects. *Changes* in work characteristics measure *developments*. This implies that the employee status quo is affected. Levels of work characteristics however focus on the degree to which a work characteristic is perceived present at a particular moment. Different interpretations of predictors may lead to differential effects. Accordingly, both sorts of predictors were included in the present study.

Considering the above, the hypotheses were in the order of consecutive analyses:

- 1) The *levels* of work characteristics have future effects on a change in the fatigue state over a one-year time interval in a population of fatigued employees
- 2) *Changes* in work characteristics have future effects on a change in the fatigue state over a one-year time interval in a population of fatigued employees

Methods

Maastricht cohort study

This study is part of the large-scale Maastricht Cohort study (MCS) on fatigue at work (Kant et al., 2003). At the start of the study, the most important aim of the selection procedure was to achieve sufficient statistical power by a large study sample and a wide variety in exposure patterns in order to be able to answer all epidemiological research questions of the cohort study. This was realized by the consent of 45 Dutch companies and organizations, covering different sectors, to participate. The majority of the participating companies were located at short geographical distance of the research group to maximize commitment and cooperation. Data were collected from 1998 until 2001 by four-monthly self-report questionnaires. The extensive version contained questions on work characteristics and fatigue. The short version contained a fatigue measurement but not work characteristics. The extensive version was administrated once a year and the short version twice a year. In this study, three extensive versions were included which means that employees were followed for two years (i.e. May 1998

until May 2000). This research framework is called a full three-wave panel design (Zapf et al., 1996). Exposure was measured in the first two measurements. A change in the fatigue state was assessed between the second and third measurement.

As in most studies on work and health, a time frame of one year is used between measurements (Zapf et al., 1996). A reason for this particular time interval is that a seasonal influence is eliminated (Frese & Zapf, 1988; Schaufeli & Enzmann, 1998; Zapf et al., 1996). A total of 12,140 employees filled out the baseline questionnaire in May 1998 (45%). Of the baseline population, 9,655 employees (80% of the initial study sample) returned the extensive questionnaire one year later in May 1999. Finally, 8,070 employees returned the questionnaire in May 2000 (67% of the initial study sample).

Inclusion and exclusion criteria

Pregnant women and employees who reported to suffer from a long-term disease (see for example Franssen et al., 2003) at any of the three measurements were excluded. These people were excluded from participation because the physical condition of these people may interfere with the aetiology and natural course of fatigue. Another group that was excluded from participation concerned employees who had been reported ill for four weeks or longer at any of the three measurements and who had not returned to work. A long time out of work may entail a biased view of the work situation. The main inclusion criterion of this study is related to the aim of the study, i.e. to study a change in the fatigue state in a fatigued population. For this reason, only those employees were selected who were fatigued at the second measurement. A clinically validated cut-off point of a self-report fatigue scale was used to discriminate between fatigued and non-fatigued employees (Bültmann et al., 2000), see also the following section on the measurement of fatigue). Because the selection of fatigued employees at the second measurement was decisive for our population at the preceding and subsequent measurements, the second measurement at which the fatigued population was selected was called T_0 and the first and third measurement T_{-1} and T_1 , respectively.

Study population

In order to check whether the study population suffered from selection problems, we compared continuous participants (i.e. T_{-1} , T_0 and T_1) with dropouts (i.e. the group of employees who did not participate at T_0 and/or T_1). After application of the exclusion criteria at T_0 (i.e. pregnant women, employees with a long-term illness and long-term sick-listed employees, the group of continuous participants consisted of 5,796 employees, and the group of dropouts consisted of 2,854 employees. A first check on selective dropout was done by comparing the scores on the research variables at T_{-1} between both groups. The differences between both groups, which pointed at more negative scores among dropouts, were small. Nevertheless, most differences reached statistical significance. The high number of employees in both groups could probably mainly explain this. An additional analysis was executed to check whether the relationships between the research variables differed between the respondent group and the dropouts. This is called a check on causal homogeneity (Hagenaars, 1990; De Jonge

et al., 2001). Cross-sectional multi-sample structural equation analyses (Jöreskog & Sörbom, 1993) convincingly revealed that the strength and direction of the relationships between the research variables were (about) the same for continuous participants and dropouts ($\Delta\chi^2(28)=21.47$, $p=ns$).

After exclusion of pregnant women, employees with a long-term illness and long-term sick-listed employees at all *three* measurements, the group of continuous participants consisted of 4,721 employees. In this population, it was investigated whether the relationships between the research variables were stationary over time. The pattern of causal relationships between the T_{-1} work characteristics and the T_0 fatigue dimensions was compared to the pattern of causal relationships between the T_0 work characteristics and the T_1 fatigue dimensions. Structural equation analyses (Jöreskog & Sörbom, 1993) in the study population without restriction of variation in fatigue revealed that the pattern of relationships was stable over time ($\Delta\chi^2(28)=28.25$, $p=ns$).

Of the group of 4,721 employees, only the 660 employees who were fatigued at T_0 were included in the analyses. The study population consisted for 81.2% of men. The mean age was 41.29 years ($sd=8.19$, range 22-62). A low educational level (i.e. primary, lower vocational or lower secondary) was reported by 29.2%, 30.9% had a medium educational level (i.e. upper secondary or intermediate vocational) and 39.9% had a high education (i.e. upper vocational or university).

Measures

Sociodemographic characteristics

Gender, educational level and age, were entered as potential confounders (e.g. Van Amelsvoort et al., 2001; Karasek & Theorell, 1990). The first two are categorical variables and were represented by dummy variables in the analyses. Age was included as a continuous variable.

Fatigue

Fatigue is best seen as a multidimensional construct (Åhsberg, 2000; Piper, 1993; Ream & Richardson, 1996; Smets et al., 1995; Yoshitake, 1978). The Checklist Individual Strength (CIS) covers the following subscales: subjective fatigue (i.e. 8 items on somatic symptoms and general feelings of fatigue), reduction in motivation (4 items), reduction in concentration (5 items) and reduction in activity (3 items) (see appendix). The items that are scored on a 7 point-Likert scale, which ranges from very often (1) to rarely or never (7). Items do not refer to the work situation but are stated in general terms. The reference period of the scale is the last two weeks and the response scale for all 20 items ranges from 20-140. A higher score means a higher degree of fatigue. The CIS was developed for clinical populations, in particular for people suffering from the chronic fatigue syndrome (Vercoulen et al., 1996a; Vercoulen et al., 1996b) but was also validated in the working population (Beurskens et al., 2000). The results of these studies show that the CIS is able to discriminate between clinical populations and employees

with fatigue complaints, and between groups of employees with expected differences in fatigue (e.g. blue collar and white collar employees).

In the present study, the four CIS dimensions were entered in the research model as separate, though associated latent variables. One reason for including the separate dimensions instead of the composite CIS-score was that the different dimensions might be predicted by different determinants (Warr, 1990; Watt et al., 2000). The fatigue dimensions can though not be seen as independently perceived concepts because together they constitute a non-specific fatigue experience (Glaus et al., 1996; Schaufeli & Houtman, 2000). In the appendix, the composition of the four CIS subscales is shown.

A change in the fatigue state in an initially fatigued population

Aim of the present study was to investigate in an initially fatigued population, the work-related determinants of a positive change in fatigue. A fatigued population was selected at T_0 by making use of a clinically validated cut-off point on the CIS, which was based on a pilot study in which several groups with expected differences in fatigue were compared by their CIS-scores. Employees scoring above the cut-off point (>76 on the total CIS-scale) are designated as probable fatigue cases, which are at risk for absenteeism and disability (Bültmann et al., 2000). Of this fatigued population, three questionnaire administrations were included in the present study. T_{-1} refers to the measurement one year *before* all of them scored above the cut-off score, and T_1 refers to the measurement *after* all of them scored above the cut-off score. Thus, at T_{-1} and T_1 no restriction was applied to the range of fatigue scores. The third measurement was used to assess our outcome, i.e. the change in fatigue scores between T_0 and T_1 in a fatigued population. In short, the range on the CIS was 20-140 at T_{-1} ; 76-140 at T_0 ; and 20-140 at T_1 .

Work characteristics

To do justice to the heterogeneity of our study population, we included a broad range of focused work characteristics. The items of all included work characteristics are described in the appendix. *Psychological job demands* were measured by a Dutch version of the Job Content Questionnaire (Houtman, 1995; Karasek, 1985). The scale originally consists of five items. Removing one item (i.e. 'I am free from conflicting demands that others make') resulted in a heightened reliability with $\Delta\alpha=.05$ for all three measurements from about $\alpha=.74$ to $\alpha=.79$. The removal was theoretically defensible because the remaining four items refer to quantitative workload and work pace and not to role conflict (De Jonge et al., 2000). The response options varied on a 4-point Likert scale from 'strongly disagree' to 'strongly agree'. *Emotional demands* were measured with four items. Three items originated from a Dutch Questionnaire on the Perception and Judgement of work (VBBA; (Van Veldhoven & Meijman, 1994), the last item on shocking events at work was self-formulated. Respondents were asked if they agreed with the statements (yes/no). *Physical demands* were overall assessed with one item: 'Do you think your work is physically demanding?'. Respondents could fill out yes (1) or no (0). This item was derived from a Dutch questionnaire on Work and Health (Gründemann et al., 1993). *Decision authority*, or the ability to make work-related decisions (Karasek &

Theorell, 1990) was measured by three items from a Dutch version of the Job Content Questionnaire (JCQ) (Houtman, 1995; Karasek, 1985). The response options varied on a 4-point Likert scale from 'strongly disagree' to 'strongly agree'. *Work scheduling autonomy* was measured by six items. These items were derived from a Dutch Monitor on Stress and Physical Demands (Houtman et al., 1993). Respondents could fill out yes (1) or no (0). *Co-worker support* was assessed by four items from a Dutch version of the Job Content Questionnaire (JCQ) (Houtman, 1995; Karasek, 1985). *Supervisor support* was assessed by four items from a Dutch version of the Job Content Questionnaire (JCQ) (Houtman, 1995; Karasek, 1985). The response options for the co-worker and supervisor support scales varied on a 4-point Likert scale from 'strongly disagree' to 'strongly agree'.

Statistical analysis

Preliminary analyses

First, descriptive statistics were calculated for all research variables ($n=660$). Second, Pearson correlations between the research variables were calculated. These analyses were performed with SPSS version 10.0.7. Third, preliminary confirmatory factor analyses (Lisrel 8.30; Jöreskog & Sörbom, 1993) were performed for two reasons. First, some of the work characteristics that were included in this study were not validated yet. Instead, items were derived from several existing questionnaires, which together were thought to give a comprehensive and unambiguous description of a particular work characteristic. Second, the consistency of factor loadings across the three measurements was tested (cf. Anderson & Gerbing, 1988; Schumacker & Lomax, 1996). Factor loadings were assessed separately for all research variables and therefore independently of the other variables that were included in this study (cf. Schumacker & Lomax, 1996). Robust factor loadings across measurements were fixed. Advantages of fixed factor loadings are that they make the assessment of the research variables less data dependent and that they allow for uniform measurements over time, which makes comparison more valid (Finkel, 1995; Rogosa et al., 1982). Fixing also increases the model parsimony (Finkel, 1995). In every first factor model that was tested, factor loadings were equal across items. When this model did not fit well, factor loadings were adjusted. Modification indices that referred to item cross loadings or item covariances were only implemented when theoretically plausible and consistent across the three measurements.

Main data analyses

Covariance structure analyses were performed with Lisrel 8.30 (Jöreskog & Sörbom, 1993), based on a covariance matrix. Missing data on the observed variables were treated by pairwise deletion. In general, the consequences of listwise and pairwise deletion are clearer for the results than the consequences of a more complex method such as data imputation. Numbers of missing values ranged from 0-19 (0-2.9%). Since missing values at first sight seemed randomly spread over the items, we chose for pairwise deletion of missing data. In this way, we made a maximum use of the data. We used Maximum Likelihood estimation. A full covariance structure model was carried out,

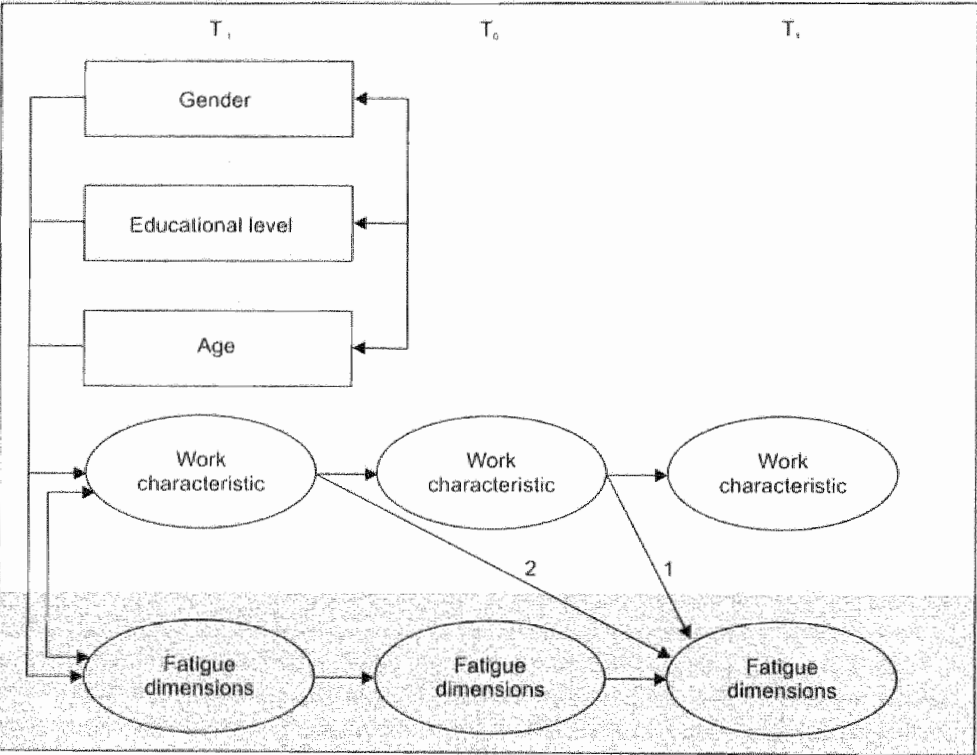
consisting of a measurement model (factor analytic model) and a structural equation model (explanatory model) in which the postulated causal relationships are determined (Jöreskog & Sörbom, 1993). The inclusion of a measurement model means that the observed variables (i.e. the items) and the latent variables (i.e. the theoretical constructs) were not considered identical. The measurement model contained fixed factor loadings that were stated in the preliminary analyses. To control for the stability of the factors, we added error covariances between identical items over time and paths between identical latent variables over time. In addition, within T_{-1} the error covariances between the work characteristics and fatigue were set free. Also, paths were assumed between the potential confounders gender, educational level and age and the T_{-1} work characteristics and T_{-1} fatigue dimensions. Finally, error covariances were set free between the several CIS dimensions within the three measurements. The reason for estimating these error covariances was that the higher-order latent variable fatigue was assumed to be the underlying factor that linked the dimensions. The error terms of the separate dimensions could thus partly be explained by the underlying factor fatigue. Figure 1 gives a graphical presentation of the postulated relationships between the (observed sociodemographic confounders and) latent variables over time.

The first model that was tested only contained effects of the levels of the T_0 work characteristics on the T_1 fatigue dimensions (hypothesis 1; figure 1). In the second research model, the effect of changes in work characteristics on a change in the fatigue state was tested (hypothesis 2; figure 1). This was tested by including the T_{-1} work characteristics in the regression equations of the first research model (Glasnapp, 1984; Maassen & Bakker, 2001). From a statistical point of view, a significant path from a T_{-1} work characteristic to a T_1 fatigue dimension represents a significant effect of a change in the work characteristic in question.

In the introduction it was argued that the study of changes in work characteristics provide stronger indications on the effectiveness of work-related interventions than the study of levels. However, in self-report studies in which change scores are modeled by within-subject change scores, the chance to find significant effects of change scores depends on the amount of change employees report over time, or on test-retest coefficients. The less changes are reported, the lower the chance to find significant effects of changes, even though in reality changes might be related to the outcome. Considering this, it was investigated in the second research model whether an effect of a level of a particular work characteristic could actually be attributed to the effect of a change in that same work characteristic. This was done by checking the relative heights of the T_{-1} and T_0 coefficients of the work characteristics (Glasnapp, 1984). Next, a third research model was fitted to our data. This third, final model was fitted because nonsignificant relationships between T_{-1} work characteristics and T_1 fatigue dimensions were redundant. Moreover, these nonsignificant paths might have caused multicollinearity in the second fitted model, due to high stability coefficients of T_{-1} and T_0 measurements of the same variables. The third model included all T_0 work characteristics plus the T_{-1} work characteristics that were found significant in the second model. This model also included

the T_{-1} work characteristics that were found large enough to assume that the change in the relevant work characteristic was nonsignificant because of too little variety in change scores. In the models we tested, alpha was set at $\alpha=.05^2$.

Figure 1 Simplified structural equations model. Path (1) represents effects of levels of work characteristics (hypothesis 1) and path (2) represents the effects of changes in work characteristics on a change in the fatigue state (hypothesis 2).



Note: The grey area indicates that every single fatigue dimension was hypothesized to predict all fatigue dimensions at the next measurement.

² In statistical terms, the following simplified research equations were tested (representing hypothesis 1 and 2 respectively):
 1) $Y \text{ (fatigue dimensions } T_1) = \beta_0 + \beta_1 \text{ (fatigue dimensions } T_0) + \beta_3 \text{ (work characteristics } T_0)$
 2) $Y \text{ (fatigue dimensions } T_1) = \beta_0 + \beta_1 \text{ (fatigue dimensions } T_0) + \beta_2 \text{ (work characteristics } T_{-1}) + \beta_3 \text{ (work characteristics } T_0)$ which can be reformulated to the following equation:
 $Y = \beta_0 + \beta_1 \text{ (fatigue dimensions } T_0) + (-\beta_2) \text{ (work characteristics } T_0 - \text{work characteristics } T_{-1}) + (\beta_3 + \beta_2) \text{ (work characteristics } T_0)$

In the output of the first and second research model, modification indices were requested to find out what specific relationships could improve the model fit (i.e. the fit between the hypothesized model and the data). When theoretically plausible, these may be important indications of neglected theoretical relationships. To assess the overall model fit, several indices were considered. First, the Chi-square statistic (χ^2) was studied. This statistic gives an indication of whether the covariance matrix matches with the hypothesized model. Second, the adjusted goodness-of-fit index (AGFI) was reported (Browne & Cudeck, 1989). This statistic takes into account the number of degrees of freedom (df), which number is an indicator of the model parsimony (cf. Schumacker & Lomax, 1996). Third, the non-normed fit index (NNFI) was reported (Bentler & Bonett, 1980). This statistic compares the hypothesized model with a model in which no relationships between the variables are postulated (i.e. the independence model). Finally, the comparative fit index (CFI) (Bentler, 1990) and the root mean square error of approximation (RMSEA; Browne & Cudeck, 1989) were reported. It should be noted though, that in the present study overall fit indices were only reported for completeness since these were less important than the direction and significance of the individual paths. This originates from the fact that the model could be subdivided into two parts. The first part concerned the determinants of the T_0 fatigue dimensions, while the second part concerned the determinants of the T_1 fatigue dimensions. In the second part, we modeled the effects of changes in the work characteristics by including a path from the T_{-1} work characteristics to the T_1 fatigue dimensions. In hypothesizing this relationship, it is clear that this relationship was also expected to exist between the ' T_{-2} ' work characteristics and the T_0 fatigue dimensions. However, the latter relationship could not be modeled. This implied that all estimated relationships with the T_0 fatigue dimensions as an outcome could be biased. Obviously, this might have led to a bad fit of the first part of the model, as represented by unfavourable overall goodness-of-fit indices. Nevertheless, the second part of the model, in which the hypothesized relationships with the T_1 fatigue dimensions as outcomes were modeled, could be measured without bias.

Results

Preliminary results

In order to give an impression of the change in fatigue in the study population, some descriptives are given. Of the study population, which consisted of 660 fatigued employees at T_0 , 53.4% scored already at T_{-1} above the fatigue cut-off score. Furthermore, of the 660 fatigued employees at T_0 , 65.1% still scored above the cut-off score at T_1 . The fact that only one third of the study population moved below the cut-off score between T_0 and T_1 stresses the robustness of fatigue (see Joyce et al., 1997 for a review on the prognosis of chronic fatigue). In table 1, descriptives are given of the study variables at T_{-1} , T_0 and T_1 . This table also contains the reliability coefficients Cronbach's alpha of the research variables. Overall, internal consistencies appeared to be reasonable to good.

Table 1 Descriptives of the study variables (n=660).

Variable (range)	M (sd) or % yes T ₋₁	M (sd) or % yes T ₀	M (sd) or % yes T ₁	Number of items	α T ₋₁	α T ₀	α T ₁
Fatigue							
Subjective fatigue (8-56)	34.58 (10.42)	39.40 (6.81)	35.82 (10.36)	8	.90	.81	.93
Reduction in motivation (4-28)	15.54 (5.25)	17.87 (4.05)	16.38 (5.46)	4	.75	.64	.85
Reduction in concentration (5-35)	17.47 (6.56)	21.24 (5.42)	19.70 (6.55)	5	.84	.80	.88
Reduction in activity (3-21)	8.86 (4.23)	10.58 (4.20)	9.77 (4.29)	3	.77	.79	.83
Psychological job demands (4-16)	11.63 (2.13)	11.69 (2.10)	11.36 (2.09)	4	.77	.79	.79
Emotional demands (0-4)	.82 (1.11)	.81 (1.06)	.75 (1.08)	4	.66	.61	.67
Physical demands (no or yes)	26.7	26.9	26.5	1	-	-	-
Decision authority (3-12)	8.55 (1.75)	8.42 (1.74)	8.57 (1.58)	3	.72	.76	.72
Autonomy work scheduling (0-6)	4.17 (1.84)	4.17 (1.92)	4.33 (1.83)	6	.77	.80	.79
Supervisor support (4-16)	10.01 (2.12)	9.74 (2.27)	9.80 (2.34)	4	.80	.85	.86
Co-worker support (4-16)	11.62 (1.48)	11.55 (1.47)	11.55 (1.50)	4	.69	.70	.72

Note: The reported scores on continuous variables were based on sum scores (factor loadings fixed at one)

The two groups in which a change in physical demands was observed (i.e. from physical demands at T₋₁ to no physical demands at T₀ and vice versa, together 12.6%) were considered too small to include in the analyses. Combining the different conditions into less dummy variables seemed arbitrary. Only the effect of the presence of physical demands at T₀ was therefore tested.

Table 2 Pearson correlations of the research variables at T_{-1} (lower left corner; 1-11), at T_1 (upper right corner; 1-11) and at T_0 at which a selection of fatigued employees was made (12-22), $n=660$. Depicted on the diagonal in bold are test-retest coefficients $T_{-1} - T_0$ (1-11) and $T_0 - T_1$ (12-22). The correlations are based on sum scores. * $p < .05$; ** $p < .01$.

T ₋₁	1	2	3	4	5	6	7	8	9	10	11	T ₁	
1	.63**	.26**	.22*	-.03	-.13**	-.19**	-.07	.28**	.22**	.20**	-.14**	1	
2	.22**	.62**	.28**	-.10*	-.32**	-.15**	-.10**	.19**	.08*	.17**	-.02	2	
3	.19**	.17**	.68**	-.28**	-.47**	-.16**	-.05	.17**	.12**	.13**	-.03	3	
4	.03	-.11**	-.31**	.63**	.38**	.34**	.21**	-.14**	-.17**	-.22**	-.13**	4	
5	-.11**	-.33**	-.42**	.33**	.83**	.19**	.08*	-.16**	-.13**	-.12**	.02	5	
6	-.18**	-.16**	-.15**	.25**	.15**	.44**	.23**	-.24**	-.19**	-.20**	-.12**	6	
7	-.05	-.08*	-.01	.08*	.01	.14**	.51**	-.13**	-.15**	-.13**	-.06	7	
8	.14**	.12**	.09*	-.05	-.04	-.14**	-.04	.32**	.63**	.53**	.28**	8	
9	.06	.03	.04	-.07	.01	-.12**	-.09*	.50**	.43**	.45**	.30**	9	
10	.01	.03	.01	-.09*	.05	-.04	-.09*	.38**	.35**	.47**	.42**	10	
11	-.24**	.03	-.12**	-.03	.09*	-.03	-.04	.18**	.28**	.40**	.47**	11	
1	psychological job demands						7	co-worker support					
2	emotional demands						8	subjective fatigue					
3	physical demands						9	reduction in motivation					
4	decision authority						10	reduction in concentration					
5	work scheduling autonomy						11	reduction in activity					
6	supervisor support												

T ₀	12	13	14	15	16	17	18	19	20	21	22
12	.59**										
13	.23**	.61**									
14	.17**	.20**	.67**								
15	-.01	-.11**	-.34**	.60**							
16	-.18**	-.32**	-.42**	.39**	.82**						
17	-.20**	-.18**	-.19**	.30**	.24**	.50**					
18	.04	0	-.01	.12**	.03	.18**	.51**				
19	.21**	.09*	.07	-.02	-.07	-.09*	.02	.31**			
20	.09*	.02	.10*	-.09*	-.02	-.11**	-.04	.14**	.44**		
21	.08*	.10*	.09*	-.06	-.03	-.03	.01	-.03	.02	.48**	
22	-.29**	-.06	-.09*	-.02	.09*	-.04	-.04	-.21**	.01	.18**	.50**
12	psychological job demands						18	co-worker support			
13	emotional demands						19	subjective fatigue			
14	physical demands						20	reduction in motivation			
15	decision authority						21	reduction in concentration			
16	work scheduling autonomy						22	reduction in activity			
17	supervisor support										

In table 2 cross-sectional Pearson correlations are depicted for the study variables. All statistically significant correlations between work characteristics and the fatigue dimensions were in the expected directions except for some associations with the fatigue dimension reduction in activity. The relationship between job demands and reduction in activity (i.e. higher job demands go together with higher activity) was the strongest correlation that was against expectation ($r_{T-1}=-.24$; $r_{T0}=-.29$; $r_{T1}=-.14$).

The relatively low correlations between the fatigue dimensions at T_0 (table 2) can be explained by the inclusion criterion of fatigued employees, which led to a restriction in fatigue scores at T_0 . It was notable that the association between subjective fatigue and activity had reversed at T_0 ($r_{T-1}=.18$; $r_{T0}=-.21$; $r_{T1}=.28$; table 2). This means that within a fatigued population, contrary to expectations, high subjective fatigue was associated with high activity.

Next to correlation coefficients, table 2 also contains test-retest coefficients at the diagonal, which for the work characteristics ranged from $r_{T-1\ T0}=.44$ and $r_{T0\ T1}=.50$ for supervisor support to $r_{T-1\ T0}=.83$ and $r_{T0\ T1}=.82$ for work scheduling autonomy (table 2, on the diagonal). With regard to the fatigue dimensions, it appeared that subjective fatigue had the lowest test-retest coefficient ($r_{T-1\ T0}=.32$; $r_{T0\ T1}=.31$). Of all fatigue dimensions, subjective fatigue thus appeared mostly sensitive to change.

In preliminary analyses, the factor loadings of all observed variables were assessed in separate factor analyses in order to state the fixed factor loadings which were to be included in the full covariance structure model. These preliminary results are shown in the appendix. In order to improve the model fit of the measurement models of the fatigue dimensions and the psychological job demands scale, some cross loadings and some error covariances were added. The final measurement models of the separate research variables showed good fit indices (NNFI \geq .90; AGFI \geq .85; (Schumacker & Lomax, 1996).

Main results

The first full covariance structure model that was tested only contained effects of levels of the T_0 work characteristics on the fatigue dimensions at T_1 . The modification indices suggested adding error covariances within $T_{1.1}$ between emotional demands and psychological job demands, between decision authority and work scheduling autonomy, and between work scheduling autonomy and physical demands. The suggested covariances were adopted since they were in line with the univariate correlations between the work characteristics (table 2). Overall fit indices of the model were rather low ($\chi^2=15811.29$, $df=9585$; AGFI=.74; RMSEA=.03; AIC=16496.43; NNFI=.87; CFI=.87). Several significant paths were found. First, high psychological job demands appeared to predict a negative change in the fatigue state in terms of an increase in subjective fatigue, and a decrease in motivation and in concentration. Second, low co-worker support appeared to predict a negative change in the fatigue state in terms of an increase in subjective fatigue and a decrease in motivation. Third, low decision authority

predicted a decrease in concentration and in motivation. No significant predictors were found for the fatigue dimension reduction in activity. In the second full covariance structure model that was tested, paths from the T_{-1} work characteristics to the T_1 fatigue dimensions were added. These paths represented the effects of the changes in the work characteristics. Fit measures did not differ very much from those found in the first model ($\chi^2 = 15781.58$, $df=9561$; AGFI=.74; RMSEA=.03; AIC=16507.73; NNFI=.87; CFI=.87). Significant effects were found for a change in work scheduling control and for a change in psychological job demands. The first effect (i.e. an increase in work scheduling control would predict a negative change in the fatigue state) could however not be replicated in further analyses (specific data not shown). Therefore, it was concluded that this effect was probably due to multicollinearity. Multicollinearity may have resulted from the inclusion of two highly correlated consecutive measurements of work scheduling control in the regression equations, but also of additional inclusion of other work characteristics which were moderately related to work scheduling control (see table 2). The second effect was robust. A decrease in psychological job demands between T_{-1} and T_0 predicted an increase in activity. This finding was in line with our second hypothesis, and may explain the earlier reported negative cross-sectional correlation coefficients between psychological job demands and activity. Modification indices were low and were therefore not adopted.

In sum, in the first fitted model seven out of 28 possible effects of levels were found significant. In the second fitted research model one out of 28 possible effects of changes in work characteristics was found significant. Next, it was investigated whether the effects of the levels of the work characteristics that were found in the first model could be partly attributed to changes in these work characteristics. This was tested in a new, intermediate research model (not mentioned in the data analysis section) because we found earlier that the regression coefficients in the full, second model, including all T_{-1} and all T_0 work characteristics, could have been affected by multicollinearity. The third model included all T_0 work characteristics, the T_{-1} work characteristic that was found significant in the second research model, and in addition the T_{-1} measurements of the T_0 work characteristics that were found significant in the first research model. The fit indices NNFI and CFI improved marginally as compared to the second model ($\chi^2 = 15797.63$, $df=9577$; AGFI=.74; RMSEA=.03; AIC=16493.83; NNFI=.87; CFI=.87). The T_{-1} and the T_0 regression coefficients of psychological job demands predicting the fatigue dimensions subjective fatigue, concentration and motivation did not differ too much in height, i.e. the T_{-1} coefficients were one third of the height of the T_0 coefficients or higher. Thus, while the level of psychological job demands had a significant effect on a change in subjective fatigue, in concentration and motivation, the (nonsignificant effect of the) *change* in psychological job demands also explained a big part of the variance in the change in these fatigue dimensions. The same conclusion was drawn with regard to the effect of decision authority on motivation. The direction of the effects of the change in psychological job demands and the change in decision authority were in line with our hypotheses. In contrast, the effect of the level of co-worker support on subjective fatigue and motivation, and the effect of the level of decision authority on concentration could

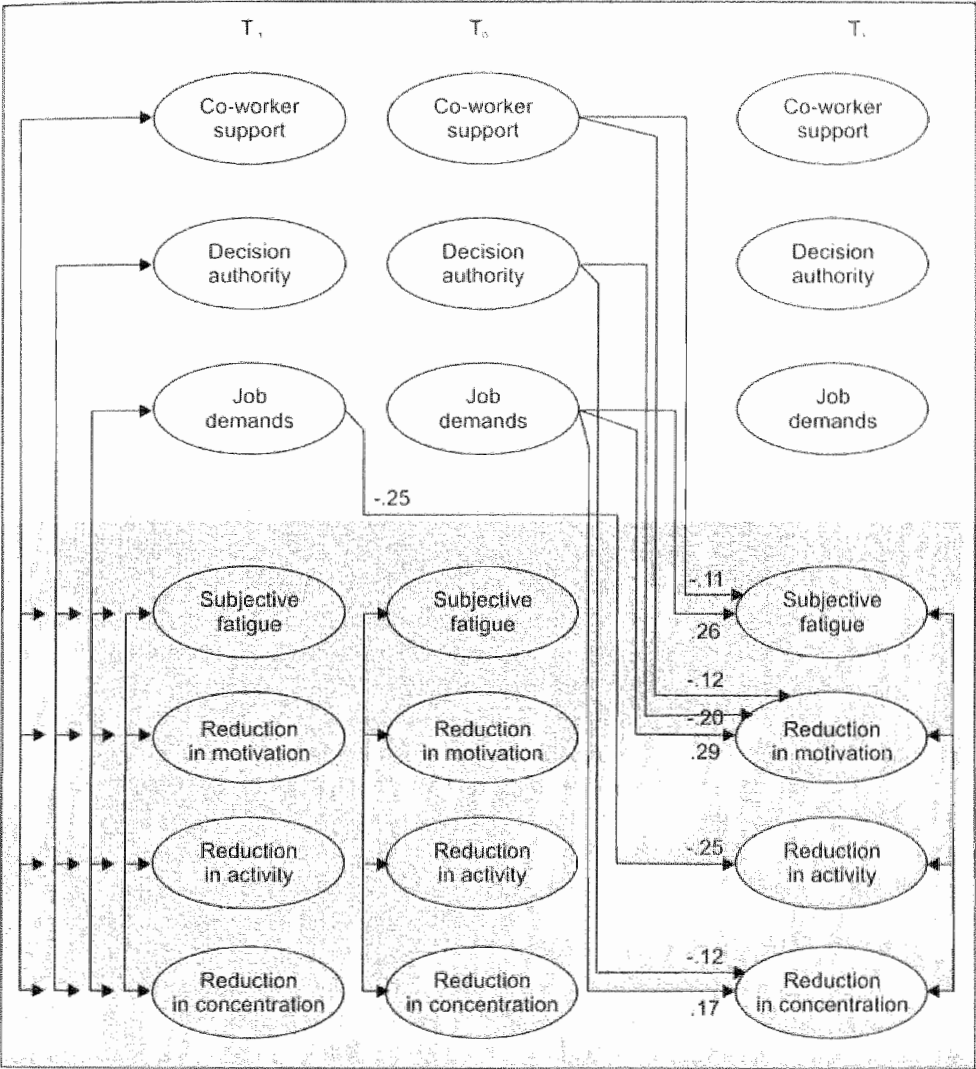
not be attributed to effects of changes in the respective work characteristics. First, even though the coefficients of the T_{-1} and T_0 measurements were of similar height, the effect of T_0 co-worker support on motivation disappeared when we controlled for the T_{-1} measurement of co-worker support. This effect was therefore not considered robust. Second, for the other two effects, the height of the T_{-1} coefficients was too low as compared to the T_0 coefficients.

A final model was fitted that integrated all of the insights from the previous models. With regard to changes in work characteristics, this model contained the effects of a change in psychological job demands on all four fatigue dimensions and the effect of a change in decision authority on motivation. Further, all of the T_0 work characteristics were included. The fit indices of the final model were: $\chi^2 = 15799.64$; $df=9580$; $AGFI=.74$; $RMSEA=.03$; $AIC=16490.39$; $NNFI=.87$; $CFI=.87$. A comparison of the very first and the last model revealed that adding the paths representing the changes in work characteristics yielded a significantly better model fit ($\Delta\chi^2(5)=11.65$, $p=.0399$). In the final model, high co-worker support predicted a positive change in subjective fatigue ($b_{T0}=-.56$; $se=.22$; $\beta=-.11$; $p=.0116$) and in motivation ($b_{T0}=-.57$; $se=.22$; $\beta=-.12$; $p=.0085$). High decision authority predicted a positive change in concentration ($b_{T0}=-.27$; $se=.10$; $\beta=-.12$; $p=.0073$). With regard to effects of (levels and) changes in work characteristics, a decrease in psychological job demands predicted a positive change in subjective fatigue ($b_{T-1}=-.26$; $se=.24$; $\beta_{T-1}=-.10$; $p=.2850$; $b_{T0}=.69$; $se=.22$; $\beta_{T0}=.26$; $p=.0023$), in motivation ($b_{T-1}=-.24$; $se=.24$; $\beta_{T-1}=-.10$; $p=.3081$; $b_{T0}=.72$; $se=.22$; $\beta_{T0}=.29$; $p=.0009$), in concentration ($b_{T-1}=-.21$; $se=.23$; $\beta_{T-1}=-.08$; $p=.3738$; $b_{T0}=.46$; $se=.21$; $\beta_{T0}=.17$; $p=.0327$) and in activity ($b_{T-1}=-.66$; $se=.23$; $\beta_{T-1}=-.25$; $p=.0041$; $b_{T0}=.30$; $se=.21$; $\beta_{T0}=.11$; $p=.1532$). Furthermore, an increase in decision authority predicted a positive change in motivation ($b_{T-1}=.24$; $se=.15$; $\beta_{T-1}=.11$; $p=.0994$; $b_{T0}=-.43$; $se=.16$; $\beta_{T0}=-.20$; $p=.0061$). The results of this model are depicted in figure 2.

Considering the relationships of the fatigue dimensions between T_0 and T_1 , it appeared that activity had a prospective effect on subjective fatigue while concentration had a prospective effect on activity. Obviously, all stability coefficients of the fatigue dimensions were also found significant. Other significant causal relationships between the fatigue dimensions were not found.

The amount of explained variance of the work characteristics in the several fatigue dimensions was 19% for subjective fatigue, 31% for reduction in motivation, 40% for reduction in concentration, and 37% for reduction in activity. These figures include the contributions of the T_0 coefficients of the dependent variables.

Figure 2 Simplified, final model with standardized coefficients. Only significant paths are shown. Effects of changes in work characteristics are represented by paths from T_{-1} work characteristics to T_1 fatigue dimensions. Effects of levels are represented by paths from T_0 work characteristics to T_1 fatigue dimensions.



Note: The grey area indicates that every single fatigue dimension was hypothesized to predict all fatigue dimensions at the next measurement.

Discussion

The aim of the present study was to investigate work-related determinants in the natural course of fatigue. Effects of changes in work characteristics as well as effects of levels of work characteristics were found predictive of a change in the fatigue state in fatigued employees. A decrease in psychological job demands was found to induce an increase in activity. With regard to the effects of levels of work characteristics, it was found that low psychological job demands predicted a decrease in subjective fatigue, an increase in motivation, and an increase in concentration. High decision authority predicted an increase in concentration and an increase in motivation. Finally, high co-worker support was found predictive of a decrease in subjective fatigue and an increase in motivation. After further study of our data, it appeared that some of these effects of levels could partly be attributed to effects of changes in these work characteristics. This conclusion applied to the effects of psychological job demands on subjective fatigue, concentration and motivation and for the effect of decision authority on motivation. Of the other found effects of the levels, the level but not the change was predictive of a change in the concerning fatigue dimensions. Third variables, that were not included in the present study, were probably responsible for these relationships (cf. Frese, 1985).

Generally, the results indicate that the study of levels and changes in work characteristics provide complementary perspectives in self-report studies. First, the effect of a decrease in psychological job demands on an increase in activity would not have been detected if only levels of work characteristics would have been investigated. Second, by studying levels next to changes we were able to distinguish between spurious relationships and intervention possibilities. Both increase the insight in the relationship between work and health in their own way. Firstly, the study of effects of changes in work characteristics provide evidence that the following interventions may be effective to prevent a prolonged fatigue state. A decrease in psychological job demands may induce a positive change in *all* fatigue dimensions in fatigued employees. Furthermore, an increase in decision authority may induce a positive change in motivation in fatigued employees. Because a decrease in psychological job demands contributed to a positive change in *all* fatigue dimensions, an intervention in this variable may be most effective. Secondly, spurious relationships between levels of predictors and an outcome, as identified in the present study, provide indications for future research. Accordingly, what third variables explain the relationships between the levels of co-worker support and decision authority on the one hand and a change in some fatigue dimensions on the other hand? Future study on these relationships might reveal alternative intervention possibilities to induce a positive change in the fatigue state in fatigued employees.

In the present study, only a selection of all included work characteristics was found to play a role in the course of fatigue. In a recent study, a relatively broader selection of all included work characteristics (i.e. levels of psychological job demands, emotional demands, physical demands, decision authority and co-worker support) was found

predictive for the onset of fatigue one year later (Bültmann et al., 2002a). Differences in study results might be explained by differences between the studies in operationalizations and analyses. However, these differences might also point at (partially) differential effects of work characteristics in the natural course of fatigue as compared to the aetiology of fatigue.

The separate fatigue dimensions were included as dependent variables instead of the comprehensive fatigue measure. The included work-related determinants appeared differentially predictive of different outcomes (cf. Broadbent, 1985; Warr, 1990). For example, high decision authority was only associated with an increase in concentration and motivation. Thus, it seems useful for future study to pay attention to the specific determinants of and to specific changes in the separate fatigue dimensions.

In general, the opportunity to find effects depends on whether the follow-up period matches the amount of time that is needed for a predictor to establish an effect (Frese & Zapf, 1988; Hagenaars, 1990). In the present study a time lag of one year was used (i.e. between T_0 and T_1). Different time lags of the effects of the (change in the) work characteristics on a change in the fatigue state should be examined in future studies (cf. Zapf et al., 1996). This is because different (work-related) predictors may affect the fatigue state over different time lags. This will lead to insight in the time that it takes to observe the strongest effects of a particular intervention. The Maastricht cohort study provides the opportunity to investigate different time lags since fatigue was measured every four months during a three-year follow-up period.

We do not expect a significant effect of capitalization on chance on our results. First, model modifications that enhance the fit may be a rather natural aspect of research in exploratory studies as the present one (Jöreskog & Sörbom, 1993; MacCallum et al., 1992). Second, we think the limited number and the nature of the adaptations on the basis of the modification indices can hardly raise any concern about capitalization on chance. Only theoretically plausible modifications were adapted (e.g. Jöreskog & Sörbom, 1993). In addition, the modifications concerning correlations between some of the work characteristics were only adapted after it was checked that these were in agreement with preliminary univariate analyses. In the measurement model, we adapted only theoretically plausible modifications that in addition were consistent across the three measurements. Thus, a rather conservative approach was followed with regard to the model modifications.

Study limitations

In the methods section we noted that serious selection problems in our study due to attrition were not expected. This conclusion was based on univariate and multivariate analyses which revealed small differences in scores, no restriction in range and no significant differences in relationships between continuous participants and dropouts. Nevertheless, we acknowledge that even though the results of these analyses look good,

these analyses are based on limited available information on dropouts. Thus, the presence of selection bias cannot be totally ruled out.

In order to make the existence of unidirectional causal relationships more plausible, it is recommended to test for nonconventional relationships (i.e. reverse causation) in addition to the postulated causation pattern (Finkel, 1995; Frese & Zapf, 1988; Williams & Podsakoff, 1989; Zapf et al., 1996). Next to the hypothesized relationships, fatigue may affect (the perception of) the work characteristics in the present study, for example via a drift of employees with an ill health to worse jobs or worse job conditions, or via a changed perception of the work situation (cf. Taris et al., 1998; Zapf et al., 1996). Unfortunately, in the present study, it was hardly possible to test equivalent reciprocal relationships, as was done in other studies (Houkes, 2002; De Jonge, 1995; Taris et al., 1998). The reason was that our study population was based on a selection of fatigued employees, which led to a restriction in fatigue scores (only) at T_0 . Nevertheless, it is recommended to investigate the effect of a prolonged fatigue state on (the perception of) work characteristics in future studies, because this may lead to additional insights in what happens to fatigued employees. Reciprocal relationships would point at the presence of a vicious circle, which would particularly stress the need for early intervention at work in fatigued employees.

The use of exclusively self-report data brings the possibility of self-report bias due to method variance or overlap in content between dependent and independent measures (e.g. Algers, 1992; Frese & Zapf, 1988). We may though have restricted unknown effects of cognitive evaluation on the results because we used a measure of fatigue that is stated in general terms (i.e. items do not refer to the work situation). Second, different response scale ranges were used. Finally, constant disturbing factors such as negative affectivity (e.g. Burke et al., 1993; Parkes, 1994) probably played a minor role in the present study. The reason is that our outcome and one category of predictors (i.e. changes in work characteristics) were based on a subtraction of two measurements (Rodgers, 1989).

The congruence of the subjective measurements with objective measurements is unknown. Some studies though showed that subjective changes in work characteristics had a basis in objective changes (Boumans & Landeweerd, 1993; De Lange et al., 2002). This entails that 'objective' work-related interventions, as summarized in the second paragraph of this section, might be effective. However, with regard to the 'objectivity' of the fatigue dimension reduction in activity, it was shown that self-report on this dimension did not match actual activity very well and that subjective fatigue was stronger related to perceived activity than to actual activity (Vercoulen et al., 1997). Thus, a decrease in psychological job demands may rather predict an increase in perceived activity than in actual activity.

The chances to recover from fatigue and the nature of the predictors of recovery from fatigue may depend on exposure time to fatigue (Bombardier & Buchwald, 1995; Clark et

al., 1995; Ridsdale et al., 1993; Vercoulen et al., 1996b). In the present study, half of the fatigued population at T_0 was already fatigued at T_{-1} . Since variation in fatigue duration at T_{-1} was largely unknown, controlling for fatigue duration in the analyses was considered arbitrary. Future studies on the natural course of fatigue may specifically focus on the effects of the fatigue duration in the relationship between work characteristics and a change in the fatigue state.

It seems clear that the course of fatigue in employees deserves more attention in future research in order to get more insight in the risk factors of a change in the fatigue state in fatigued employees. The present study provides indications that work-related predictors may have a less pronounced effect in the course of fatigue in comparison with the aetiology of fatigue. Future studies may reveal other factors that are predictive of a change in the fatigue state. Other predictors may include health-related variables (i.e. general health, psychological distress, help-seeking behaviour), personality (i.e. coping, negative affectivity), private situation (i.e. family support, domestic load), and life-style factors (i.e. physical activity during leisure time, alcohol consumption). Some of these factors were already studied in the aetiology of fatigue (Bültmann et al., 2002c). In this way, future studies will shed more light on equal as well as distinctive predictors in the aetiology and natural course of fatigue and its separate dimensions. Moreover, these studies may reveal more on the effectiveness of *non-work* related interventions in the prevention of a prolonged fatigue state.

Acknowledgements

The Maastricht cohort study is part of the Netherlands concerted action on 'Fatigue at work', which was granted by the Netherlands Organisation for Scientific Research (NWO). The present study was supported by NWO grant no. 580-02.252.

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Appendix

20-item 'Checklist Individual Strength'

1. I feel tired
2. I feel very active (reversed)
3. Thinking requires effort
4. Physically I feel exhausted
5. I feel like doing all kind of nice things (reversed)
6. I feel fit (reversed)
7. I do quite a lot within a day (reversed)
8. When I am doing something, I can concentrate very well (reversed)
9. I feel weak
10. I don't do much during the day
11. I can concentrate well (reversed)
12. I feel rested (reversed)
13. I have trouble concentrating
14. Physically I feel I am in a bad condition
15. I am full of plans (reversed)
16. I am tired very quickly
17. I have a low output
18. I feel no desire to do anything
19. My thoughts easily wander
20. Physically I feel in a good shape (reversed)

Preliminary results

Composition of CIS dimensions and fixed factor loadings between brackets for T_{-1} , T_0 , T_1 :

Subjective fatigue:	items 1 ($\lambda=1$), 2 ($\lambda=.5$), 4 ($\lambda=1$), 6 ($\lambda=1$), 9 ($\lambda=1$), 12 ($\lambda=1$), 14 ($\lambda=1$), 16 ($\lambda=1$), 20 ($\lambda=1$)
Reduction in motivation:	items 2 ($\lambda=.5$), 5 ($\lambda=1$), 15 ($\lambda=.75$), 17 ($\lambda=.5$), 18 ($\lambda=1.25$)
Reduction in concentration:	items 3 ($\lambda=.75$), 8 ($\lambda=1$), 11 ($\lambda=1$), 13 ($\lambda=1$), 19 ($\lambda=1$)
Reduction in activity:	items 7 ($\lambda=1$), 10 ($\lambda=1.25$), 17 ($\lambda=.75$)

Composition and fixed factor loadings between brackets of work characteristics for T_{-1} , T_0 , T_1 :

Psychological job demands

1. My job requires working very fast ($\lambda=.75$)
2. My job requires working very hard ($\lambda=1$)
3. I am not asked to do an excessive amount of work (reversed, $\lambda=1$)
4. I have enough time to get the job done (reversed, $\lambda=1$)

Note. Additional error covariance between the first and second item.

Emotional demands

1. Are you often confronted with personally upsetting things in your work? ($\lambda=2$)
2. Do you often feel personally attacked or threatened in your work? ($\lambda=1$)
3. Does your work often involve moving work situations? ($\lambda=1.5$)
4. Did you experience one or more shocking events at work during last year, e.g. accident,

violent crime, sexual harassment, aggression at work?
($\lambda = 1$)

Decision authority

1. My job allows me to make a lot of decisions of my own ($\lambda = 1$)
2. On my job, I have very little freedom to decide how I do my work (reversed, $\lambda = .75$)
3. I have a lot to say about what happens on my job ($\lambda = 1$)

Work scheduling autonomy

1. Can you easily leave your work place for a moment? ($\lambda = 1$)
2. Can you pause in your work when you think that is necessary? ($\lambda = 1$)
3. Can you control the working speed? ($\lambda = 1$)
4. Can you choose the time at which you start working or stop working? ($\lambda = 1$)
5. Can you choose for yourself when you pause? ($\lambda = 1$)
6. Can you take a day off whenever you want? ($\lambda = .75$)

Co-worker support

1. People I work with are competent in doing their jobs ($\lambda = 1$)
2. People I work with take a personal interest in me ($\lambda = 1.5$)
3. People I work with are friendly ($\lambda = 1$)
4. People I work with are helpful in getting the job done ($\lambda = 1.5$)

Supervisor support

1. My supervisor is concerned about the welfare of those under him ($\lambda = 1$)
2. My supervisor pays attention to what I am saying ($\lambda = 1$)
3. My supervisor is helpful in getting the job done ($\lambda = .75$)
4. My supervisor is successful in getting people to work together ($\lambda = .75$)

Theoretical justification of cross loadings and error covariances

Fatigue dimensions: measurement model

Starting-point for our analyses were the original subscales subjective fatigue and reduction in motivation, activity and concentration of the Checklist Individual Strength (Vercoulen et al., 1999; Vercoulen et al., 1996a; Vercoulen et al., 1994). These were included as separate latent variables, which were assumed to underlie together the multidimensional construct of 'fatigue'. To improve the model fit we added two cross loadings and five error covariances. A first cross loading was found for the item 'I feel very active' which appeared to apply not only to the subscale motivation but also to the subscale subjective fatigue. A second cross loading was found for the item 'I have a low output' which applied not only to the subscale activity but also to the subscale motivation. The first cross loading might be explained by the fact that the meaning of the word activity in the item 'I feel very active' is closely connected to a lot of statements within the subscale subjective fatigue because of the referral in this item to general feelings of physical and mental exhaustion. The item 'I feel very active' of the subscale motivation appeared not only connected with the subscale subjective fatigue by this cross loading, but in addition an error covariance was found between this item and the item 'I feel fit', which also belongs to the subscale subjective fatigue. In addition, an error covariance was found between the item 'I feel tired' and the item 'Physically I feel exhausted'. These two error covariances can probably be explained by the close connection of the contents of these items in spoken language. A precondition for feeling active seems to be physical fitness, while tiredness and exhaustion are concepts that in spoken language have similar meanings. One other error covariance within the subscale subjective fatigue was found between the items 'Physically I

feel in a good shape' and 'Physically I feel I am in a bad condition'. Though these items are posed in the opposite direction, the contents of these items are very much alike. Both contain the word 'physically' and both refer to the concept of 'physical condition' in general.

Another error covariance was found within the subscale 'motivation' between the items 'I feel like doing all kind of nice things' and 'I am full of plans' which both explicitly refer to the motivation to do amusing activities in spoken language. The other items in this subscale, i.e. 'feeling very active' and 'feeling no desire to do anything' are stated more general and their contents are more distinguishable from each other and from the other items in the scale.

The last error covariance was found within the subscale 'concentration' between the items 'When I am doing something, I can concentrate very well' and the item 'I can concentrate well'. Both items contain about the same words, and both are formulated positively, which might explain why these two items were more strongly associated than the rest of the items within this subscale. The three other items were posed negatively and used other words to operationalize concentration.

In sum, three error covariances were found within the subscale subjective fatigue, one within the subscale motivation and one within the subscale concentration.

Psychological job demands: measurement model

One error covariance was added between the items 'working hard' and 'working fast'. An explanation for the covariance between the error terms may be that both formulations are very much alike, while the items were consecutively included in the questionnaire. Furthermore, both items are used interchangeably in spoken language.

4

Fatigue as a predictor of sickness absence: results from the Maastricht cohort study on fatigue at work

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Abstract

The objective was to investigate whether there is a relationship between fatigue and sickness absence. Two additional hypotheses were based on the theoretical distinction between involuntary, health-related absence and voluntary, attitudinal absence. In the literature, the first mentioned is usually used to describe long term sickness absence, the latter relates to short term sickness absence. In line with this, the first additional hypothesis was that higher fatigue would correspond with a higher risk of long term, primarily health-related absence. The second additional hypothesis was that higher fatigue would correspond with a higher risk of short term, primarily motivational absence. A multidimensional fatigue measure, as well as potential sociodemographic and work related confounders were assessed in the baseline questionnaire of the Maastricht cohort study on fatigue at work. Sickness absence was objectively assessed on the basis of organisational absence records and measured over the six months immediately following the baseline questionnaire. In the first, general hypothesis the effect of fatigue on time-to-onset of first sickness absence spell during follow up was investigated. For this purpose, a survival analysis was performed. The effect of fatigue on long term sickness absence was tested by a logistic regression analysis. The effect of fatigue on short term sickness absence was investigated by performing a survival analysis with time-to-onset of first short absence spell as an outcome. It was found that higher fatigue decreased the time-to-onset of the first sickness absence spell. Additional analyses showed that fatigue was related to long term as well as to short term sickness absence. The effect of fatigue on the first mentioned outcome was stronger than the effect on the latter outcome. Potential confounders only weakened the effect of fatigue on long term absence. Thus, fatigue as measured with the Checklist Individual Strength can be used as a screening instrument to assess the likelihood of sickness absence in the short term.

Introduction

Sickness absence is a complex phenomenon since its occurrence and course are influenced by a range of factors, including social factors (e.g. social security system, health care, culture), work related factors (e.g. work content, work conditions), organisational factors (e.g. company size, the existence of health promotion programs and absence policies) and individual factors (e.g. personality, health) (Alexanderson, 1998; Kristensen, 1991; Niedhammer et al., 1998; Savikko et al., 2001). Sickness absence can be seen as a coping mechanism. It may be a reaction to symptoms of stress or ill health or it may be a reaction to the perceived causes of these symptoms (Dwyer & Ganster, 1991; Kristensen, 1991). In this way, absence can be the result of ill health or it can be the result of a negative attitude towards the job originating from for instance a low motivation, low satisfaction or low commitment. Either or both can contribute to the decision to report oneself ill (Steers & Rhodes, 1978). In the literature short term sickness absence and a high absence frequency are assumed to be more related to attitude (Chadwick-Jones et al., 1982; Stansfeld et al., 1999). Long term sickness absence is suggested to be particularly related to ill health and inability to perform work tasks (Marmot et al., 1995; Stansfeld et al., 1999). As such, long term sickness absence is referred to as a primarily involuntary absence measure while short term absence and absence frequency can be seen as primarily voluntary absence measures (Geurts et al., 1994; Marmot et al., 1995). This dual explanation for sickness absence is related to the fact that in most countries a medical certificate is required after a certain number of absence days (Marmot et al., 1995). In line with the above-mentioned theoretical distinction, several authors have reported different risk factors of long term and short term absence or of absence duration and of frequency (Dwyer & Ganster, 1991; Marmot et al., 1995; Niedhammer et al., 1998; Smulders & Nijhuis, 1999).

The aim of the present study was to investigate fatigue as a predictor of sickness absence. Fatigue is found prevalent in the general population (Loge et al., 1998; Pawlikowska et al., 1994), in clinical populations (Chen, 1986) and in employees (Bültmann et al., 2002b). There are several reasons why fatigue may be an important predictive factor for sickness absence (Schröer, 1997; Terluin & Van der Klink, 1993). First, there is a high prevalence of fatigue cases in the working population (Bültmann et al., 2002b). Second, the fatigue state was found rather robust (Janssen et al., submitted). Third, fatigue can be a disabling condition (Wessely, 2001). Finally, in the Netherlands a substantial proportion of the employees who receive a sickness or disability benefit are given the diagnostic label of 'adaptive or exogenous reaction' within the ICD-10. This diagnostic group includes job stress, overstrain and burnout (Csányi, 1999; Van Eck, 1991). Fatigue is an important symptom of the mental, stress-related health complaints that fall within this diagnostic group (Terluin & Van der Klink, 1993; Terluin & Van der Klink, 1996).

In the literature, fatigue is generally described and measured as a multidimensional phenomenon (e.g. Lewis & Wessely, 1992; Smets et al., 1995; Wessely, 2001). Indeed in previous studies, cognitive, motivational and physical fatigue dimensions were strongly interrelated (Janssen et al., submitted; Vercoulen et al., 1994). Fatigue was hypothesized and found to have a multifactorial aetiology (Bültmann et al., 2002a; Bültmann et al., 2002b; Lewis & Wessely, 1992; Meijman & Schaufeli, 1996; Wessely, 2001). The severity of fatigue is continuously distributed in the population (Loge et al., 1998; Pawlikowska et al., 1994; Wessely, 2001). In previous studies, fatigue was strongly associated with a bad mental health state, impaired functioning and a variety of long term illnesses (Beurskens et al., 2000; Bültmann et al., 2002b; Loge et al., 1998; Vercoulen et al., 1994; Vercoulen et al., 1996a). However, just like sickness absence, fatigue is a non-specific measure which may also reflect attitudes. The relationship between fatigue and attitude or motivation is less established thus far in comparison with the relationship between fatigue and ill health.

In previous studies, attitude as represented among others by job satisfaction and commitment, appeared to be related primarily to short term sickness absence and absence frequency (Cheloha & Farr, 1980; Hackett et al., 1989; Marmot et al., 1995). In the last decade health has been given more attention as a potential predictor of sickness absence (Nijhuis & Smulders, 1996; Smulders & Nijhuis, 1999). Physical, mental and general health indicators appeared to be predictive particularly of long term sickness absence (Bourbonnais & Mondor, 2001; Hendrix & Spencer, 1989; Hensing et al., 1997; Jenkins, 1985; Kristensen, 1991; Marmot et al., 1995; Nijhuis & Smulders, 1996; Smulders & Nijhuis, 1999). In a study of De Croon and colleagues (2003), need for recovery was found predictive of future long term sickness absence (>14 days). Need for recovery is a measure of acute work related fatigue. Under conditions of prolonged exposure to work related stressors and insufficient recovery, acute fatigue is assumed to lead to cumulative health deterioration and sickness absence (De Croon et al., 2003; Kompier et al., 1990; Meijman, 1989). Thus far though, the effect of long term, general fatigue on sickness absence has not been investigated in a structured manner.

In the present study we firstly tested whether there is a relationship between fatigue and sickness absence in general. To get more insight in this relationship, two additional hypotheses were formulated which were based on the distinction between primarily health-related, long term absence and primarily attitudinal, short term absence. In line with this distinction, the first additional hypothesis was that higher fatigue goes together with a higher risk for long term absence. The second additional hypothesis was that higher fatigue goes together with an increased risk for short term absence. As mentioned before, fatigue was often found related to ill health in the literature. To a far lesser extent fatigue was investigated in relation to motivation or described as an expression of motivation or attitude. Since previous studies showed that ill health was more related to long term absence than to short term absence (Marmot et al., 1995), the effect of fatigue on long term sickness absence was expected to be stronger than the effect of fatigue on short term sickness absence.

Work characteristics such as job demands, control and social support and sociodemographics may confound the relationship between fatigue and sickness absence 1) since these are associated with fatigue (Bültmann, 2002) and 2) because they play a role in the aetiology of sickness absence (Alexanderson, 1998; Niedhammer et al., 1998; North et al., 1996; Smulders & Nijhuis, 1999; Vahtera et al., 1996). Similar combinations of factors were investigated in earlier studies (De Croon et al., 2003; Smulders & Nijhuis, 1999). The potential confounding of the sociodemographics and the work related characteristics may relate to an underlying motivational or health-related mechanism with regard to the relationship between fatigue and sickness absence. These confounders were therefore included in all analyses.

Methods

Maastricht cohort study

This study is part of the large-scale Maastricht cohort study (MCS) on fatigue at work (1998-2001). A heterogeneous cohort coming from 45 different companies and institutions was followed for three years by four-monthly self-report questionnaires. The prospective study design made it possible to investigate the relationship between fatigue and future sickness absence. The baseline questionnaire of the MCS, which was administrated in May 1998, was used to determine fatigue and the potential confounders (i.e. work characteristics and sociodemographic characteristics). For the present study, absence data for the period July-December 1998 were used, which covered the six months following the administration of the baseline questionnaire.

Inclusion and exclusion criteria

Employees who were fully or partially sick-listed at the time of the baseline questionnaire were excluded from the study population. It was argued that the perception of the work situation of long term sick-listed employees might be biased because of work related sickness absence or recall bias as a consequence of time out of work. Furthermore, sickness absence is a strong predictor of future absence behaviour (e.g. Smulders & Nijhuis, 1999; Vahtera et al., 1996). The exclusion of absent employees at baseline does more justice to the aim of the present study to examine the effect of fatigue on future sickness absenteeism. Second, employees who reported to suffer from a long term illness at baseline were excluded because the illness may affect sickness absence behaviour directly or indirectly via the aetiology and natural course of fatigue. Third, employees with more than one contract were excluded. The need or the motivation to report sick in one job may lead to the systematic actual initiation of sickness absence in the 'other' job. Finally, women who were on the sick list because of pregnancy or maternity leave were excluded from participation.

Study population

In the present study, organisational absence records from 40 participating companies and institutions were used. Other companies were not able to deliver sick leave data due to technical reasons. This means that for 10,956 participants of the baseline measurement, sick leave data were available. After application of the exclusion criteria, 7495 cohort participants were available for analysis. The main part of the excluded subjects had a long term illness; other exclusion criteria were smaller in terms of the number of excluded subjects.

Measures

Fatigue

In this study, fatigue was measured with the Checklist Individual Strength (CIS) (Vercoulen et al., 1994; Vercoulen et al., 1999). The CIS contains 20 items that are scored on a 7-point Likert scale. It is a multidimensional self-report questionnaire that covers the following subscales: subjective fatigue (i.e. eight items on somatic symptoms and general feelings of fatigue), reduction in motivation (four items), reduction in concentration (five items) and reduction in activity (three items). Items do not refer to the work situation but are stated in general terms. The reference period of the scale is the last two weeks. The CIS was developed for clinical populations, in particular for people suffering from the chronic fatigue syndrome (Vercoulen et al., 1994; Vercoulen et al., 1996a; Vercoulen et al., 1996b) but was also validated in the working population (Beurskens et al., 2000). In the present study we used the total fatigue score, which was based on all 20 items. Reliability of the scale was good, as expressed by a Cronbach's alpha coefficient of $\alpha = .93$. The response scale ranged from 20-140. A higher score means a higher degree of fatigue. A CIS-total cut-off point was stated in a pilot study (Bültmann et al., 2000). It was based on samples with expected differences in fatigue levels. Employees scoring above the cut-off were designated as probable fatigue cases and as being 'at risk' for sickness absence or work disability (Bültmann et al., 2000). In the statistical analyses, we included fatigue as a continuous variable. The CIS cut-off point was only used for graphical presentation of some results.

Potential confounders

Sociodemographics and work characteristics were included as potential confounders. Educational level and gender were included as dummy variables. Educational level was operationalised as low (i.e. primary school, lower vocational education or lower secondary school), medium (i.e. intermediate vocational education or upper secondary school) and high (i.e. upper vocational education or university). Age was included as a continuous variable. Work related confounders were operationalised by measures of psychological demands, skill discretion, decision authority, supervisor and co-worker support (Johnson & Hall, 1988; Karasek, 1979; Karasek & Theorell, 1990). These variables were measured by a Dutch version of the Job Content Questionnaire (JCQ) (Houtman, 1995; Karasek, 1985). *Psychological job demands* were measured with five items on quantitative workload, work pace and conflicting demands. *Decision authority* was measured with three items on the ability to make work related decisions (Karasek &

Theorell, 1990; Karasek et al., 1998). *Skill discretion* was measured with five items, covering elements of task variety and creativity required on the job (Karasek et al., 1998). *Social support from co-workers and supervisor social support* were both assessed with four items. The response options for the work characteristics varied on a 4-point Likert scale from 'strongly disagree' to 'strongly agree'. The internal consistency of the scales was moderate to good, ranging from $\alpha=.69$ for psychological job demands to $\alpha=.84$ for supervisor support. A higher score indicated higher demands, higher control and higher support.

Sickness absence

The use of objective absence data was expected to reduce self-report bias (Frese & Zapf, 1988; Vahtera et al., 2000). We firstly wanted to know whether there is a relationship between fatigue and sickness absence. For this end we operationalised sickness absence as the time to the onset of the first absence spell. All first absence spells, regardless of duration, were included. In the analysis in which the additional hypothesis on the relationship between fatigue and long term sickness absence was investigated, we used the time-lost index. The group of employees with more than 42 calendar days of sickness absence over half a year was contrasted with the group of employees with 0-7 calendar days of sickness absence. In the Netherlands, most employees are called for consultation by an occupational physician within the first couple of weeks after the onset of the sick leave (De Rijk et al., 2002). By that time employees will have been asked to provide information on the reason of the sick leave and many will have undergone a physical examination. Thus overall, sickness absence of more than 42 days can be considered as certified. In the analysis in which the relationship between fatigue and short term absence was tested, time-to-onset of the first short sickness absence spell was taken as an outcome. We included time-to-onset in this particular outcome, because the variety in time-to-onset of the first short absence spell was high. Moreover, in general a higher absence frequency is related to a shorter time-to-onset of the first absence spell. The inclusion of time-to-onset in the short term absence operationalisations therefore emphasizes the theoretical distinction between primarily health-related, long term absence and primarily attitudinal, short term absence.

Statistical analysis

Descriptives were calculated for the study population (table 1). All data analyses in which the hypotheses were tested were executed in two steps. First, fatigue was included to calculate a crude effect of fatigue on sickness absence. Second, potential sociodemographic and work related confounders were included altogether. The hypothesis that postulated that high fatigue leads to an increased sickness absence risk in general and the one that postulated that high fatigue leads to an increased risk of a short term sick leave episode, were tested by executing survival analyses (Cox proportional hazards modelling). In the survival analyses, all employees who were absent from work at the beginning of follow up (i.e. the 1st of July) were excluded. The relative risks per standard deviation of change in fatigue were calculated together with their 95% confidence intervals. The results of the first hypothesis were visualised in a

graph in which fatigue was dichotomised at the earlier described CIS-total cut-off point (Bültmann et al., 2000). The analyses were performed in the SAS program (SAS Institute, 1989). The hypothesis on the relationship between fatigue and long term sickness absence was tested by a logistic regression analysis. An odds ratio and its 95% confidence interval again indicated the relative risk of long term sickness absence per standard deviation of change in fatigue.

Results

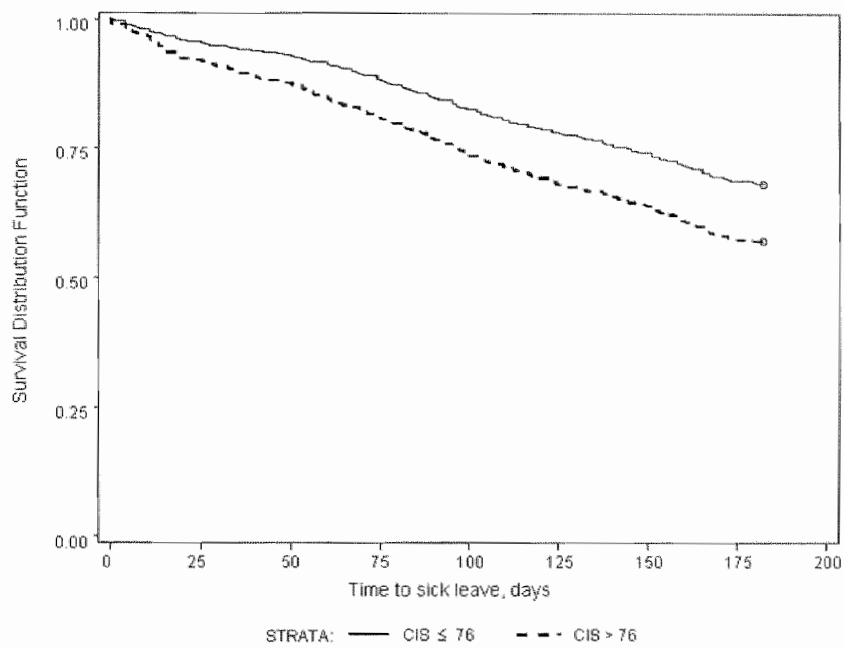
The means and standard deviations of all study variables are depicted in table 1. The study population consisted of 7495 employees, of whom 74.5% was male. A low educational level was reported by 30.0% of the study population, 32.3% had a medium educational level and 37.7% had a high education. The mean age was 40.36 (sd=8.86; table 1). For further details on the descriptives of the potential work related confounders see table 1. The mean fatigue score was 53.35 (sd=21.62). Of the study population, 147 employees were on sick leave at the 1st of July in 1998. This group was excluded from the survival analyses.

Table 1 Descriptives of the study population.

Variable	Total group (n=7274 - 7494) M (sd) or %
Fatigue	53.35 (21.62)
% Education low	30.0
% Education medium	32.3
% Education high	37.7
Age	40.36 (8.86)
% Male	74.5
Psychological job demands	33.06 (5.60)
Skill discretion	36.76 (5.43)
Decision authority	35.83 (6.93)
Supervisor support	10.59 (2.27)
Co-worker support	11.92 (1.55)

In a preliminary analysis, it was tested whether there is a relationship between fatigue and the risk of reporting ill, independent of absence duration. The survival analysis indicated that higher fatigue predicted a quicker onset of the first sick leave episode (crude RR=.83, 95% CI=.80-.86; adjusted RR=.85, 95% CI=.81-.88). The potential sociodemographic and work related confounders had no effect on the height of the crude RR of fatigue. The results are graphically presented in figure 1.

Figure 1 Survival plots of the relative risk of reporting sick for employees designated as probable fatigue cases (CIS>76) and employees not designated as probable fatigue cases (CIS≤76).



In this figure, the unadjusted relationship between fatigue and time-to-onset of the first sickness absence spell (regardless of duration) is visualised by making use of the CIS-total cut-off point that was described earlier. The survival plot shows that the time-to-onset of the first sickness absence spell is shorter for probable fatigue cases in comparison with employees who are not designated as probable fatigue cases.

To further explore the relationship between fatigue and sickness absence, our first additional hypothesis was that higher fatigue increases the future likelihood to report sick for more than 42 days. The results are shown in table 2. The ORs represent the increase of the likelihood of long term sickness absence, in case of an increase of the size of a standard deviation on the fatigue scale. Fatigue had a strong effect on long term sickness absence, both before and after controlling for confounding (crude OR=1.53, 95% CI=1.36-1.72; adjusted OR=1.40, 95% CI=1.23-1.61).

Our second additional hypothesis was that higher fatigue increases the likelihood of short term absence. This was investigated by a survival analysis in which time-to-onset of first short sick leave episode was taken as an outcome. The results confirmed our hypothesis (table 3; crude RR=.85, 95% CI=.81-.89; adjusted RR=.85, 95% CI=.81-.90). The results were comparable to those found while testing our first, general hypothesis on the relationship between fatigue and sickness absence.

Table 2 Fatigue as a predictor of long-term sickness absence. Number of subjects, crude ORs and adjusted OR.

	N*	OR†	95% CI	n*	OR‡	95% CI
0-7 days	6277	1		5862	1	
>42 days	257	1.53	1.36-1.72	229	1.40	1.23-1.61

* Difference with total study population due to the restricted variety in sickness absence (0-7 or >42 days) or due to missing data on one or more research variables

† Crude odds ratio, increase per standard deviation in fatigue score

‡ Adjusted for gender, educational level, age, psychological demands, skill discretion, decision authority, supervisor support and co-worker support, increase per standard deviation in fatigue score

Table 3 Fatigue as a predictor of time-to-onset of first short sickness absence spell. Number of subjects, crude RR and adjusted RR.

	N*	RR†	95% CI	n*	RR‡	95% CI
Incident short-term sick leave	6584	.85	.81-.89	6153	.85	.81-.90

* Difference with total study population due to sick leave on the 1st of July 1998, due to restricted variety in sickness absence (no absence spells during follow-up or first short absence spell) or due to missing data on one or more research variables

† Crude odds ratio, increase per standard deviation in fatigue score

‡ Adjusted for gender, educational level, age, psychological demands, skill discretion, decision authority, supervisor support and co-worker support, increase per standard deviation in fatigue score

Discussion

The aim of the present study was to examine the effect of fatigue on future sickness absence. Future sickness absence was measured over the six months following the fatigue measurement. Advantages were the prospective design and the objective sickness absence measure that was included. There appeared to be a relationship between fatigue and sickness absence. While further exploring this relationship, it appeared that fatigue was particularly strongly related to long term sickness absence. Nevertheless, the relative risk of fatigue for a quick onset of short term sickness absence episode was also found significant. The fact that the relative risk of fatigue for long term sickness absence was decreased when potential confounding of sociodemographics and work related factors was controlled for, points at complex relationships between these factors, fatigue and sickness absence. The fact that the confounders did not affect the relative risk for short term sickness absence points at differential underlying causal mechanisms for short term and long term sickness absence.

As already was mentioned in the introduction, in the literature short term sickness absence is often referred to as voluntary, motivational absence, while long term sickness absence is mostly referred to as health-related, involuntary sickness absence. Following this reasoning while interpreting the stronger effect of fatigue on long term than short term absence, the conclusion can be drawn that high fatigue may be less of an indicator or correlate of bad motivation or attitude than of ill health. This interpretation fits in with the presentation of fatigue in the literature as a disabling condition (Wessely, 2001).

Next to an effect of fatigue on the number of absence days, we found that fatigue was predictive of a quick onset of the first (short) sickness absence spell. As already mentioned, there is a strong relationship between absence frequency and time-to-onset of a sick leave episode. This is because more frequent absence episodes are automatically distributed over a longer time period, which implies a higher chance of a quick onset of the first absence spell. A single absence spell though may occur at every moment in the period over which absence is measured. Therefore, the results of the analyses on time-to-onset of first sickness absence spell also in a way refer to absence frequency.

The present study was based on a prospective design. By predicting future sickness absence behaviour in a population of employees who were not on sick leave at the time of the measurement of the predictors, we tried to make the causal direction of fatigue on future sickness absence more plausible. Nevertheless, the possibility of bi-directional or (solely) reverse causation cannot be ruled out (Tharenou, 1993). This is because part of the relationship between fatigue and future sickness absence may still be explained by a cross-sectional relationship at baseline between fatigue and sickness absence history. However, solely reverse causation seems unlikely since it does not seem plausible that the strong effects of fatigue we found, particularly on long term sickness absence, will disappear when an effect of sickness absence on future fatigue is introduced in the model.

Notwithstanding the above-mentioned, the exclusion of sick-listed employees at baseline may have led to an underestimation of the relationship between fatigue and sickness absence because we may have excluded a less healthy population with probably higher absence rates. Furthermore, fatigue and the work related confounders were assessed within the same questionnaire. This may have led to self-report bias originating from for example cognitive consistency, negative affectivity, or a bad work attitude (Algera, 1992). In this way, controlling for potential confounding may have led to an underestimation of the effects of fatigue on the outcomes. However, we found no indications of inflated correlations between the work characteristics and fatigue, nor did we systematically find that the work related confounders strongly affected the effect of fatigue on sickness absence.

The results of the present study apply to a follow up period of six months. The length of the follow up period of employees is often an arbitrary choice, but appeared well-chosen

since we found a rather strong effect of fatigue on sickness absence for this follow up period. Furthermore, since the period immediately followed the fatigue measurement, it can be concluded that the time lag of the effect of higher fatigue on sickness absence was short. Future studies may shed more light on whether the effect of fatigue on sickness absence may be extended to a longer follow up period.

It seems that the multidimensional fatigue instrument which was used in the present study is a useful screening instrument for employees at risk for sickness absence. This procedure might be included in the sociomedical guidance or health surveillance by occupational health services. Using the fatigue instrument also facilitates the establishment of priorities with regard to the timing of interventions for specific risk groups since time-to-onset of first sick leave episode was found to be shorter for employees with a higher fatigue score. The results subscribe and extend the results from a recent study, in which the same fatigue measurement as was used in the present one was found to be strongly predictive for work disability (Van Amelsvoort et al., 2002).

As already mentioned, the present study is an important starting-point to further investigate the underlying causal chain of health-related and attitudinal reactions that underlie the effect of fatigue on long term and short term sickness absence respectively. Moreover, it is recommended to study predictors of sickness absence across specific diagnosis groups as a refinement of the present study. This will not only increase insight but will also shed more light on the contents of interventions to prevent sickness absence or to shorten its duration.

Acknowledgements

The Maastricht cohort study is part of the Netherlands concerted action on 'Fatigue at work' which was granted by the Netherlands Organization for Scientific Research (NWO). The present study was supported by NWO grant no. 580-02.252.

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5

The Demand Control Support Model as a predictor of return to work

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Abstract

In the present study, work-related determinants of return to work were investigated. Our hypothesis was based on the strain hypothesis of the Demand-Control-Support model, which postulates a relation between job demands, job control and support at work on the one hand, and the aetiology of health complaints on the other hand. High demands were hypothesized to obstruct return to work, while high control and high support were thought to have a positive effect on return to work. This hypothesis was tested in a population of employees who were sick-listed for six to eight weeks. Return to work as operationalized by the categories not working, return to work with adjustments and full return to work, was determined four months after the onset of the sick leave. The hypothesis was tested by logistic regression analyses. Indeed, high job demands were the least predictive of full return to work. However, the likelihood of employees with high job demands to return to work with adjustments was higher than the likelihood of not working. Therefore, job demands may also work as a pressure to attend (cf. Smulders & Nijhuis, 1999). Furthermore, high skill discretion in combination with high job demands predicted working with adjustments as compared to not working. Finally, high supervisor support was the most predictive of return to work without adjustments and the least predictive of not working.

Introduction

Long-term sickness absence is an important issue in the Netherlands considering the social and financial costs it brings with it (Koningsveld & Mossink, 1997). During the first year of the sick leave in the Netherlands, the employer is legally obliged to compensate for at least 70% of the income, which amount in most companies is increased to 100% by collective agreements. If employees are still (partially) disabled for work after this first year of sick leave, employees are assessed for their work ability to determine whether they are entitled to receive a disability benefit. Disability benefits are borne by society. However, direct compensation costs are not the only costs of sickness absence within the organization. Long-term absence affects the work situation, whether the employee is replaced or not. For example, the replacement will have to settle in a job, or some colleagues in the same job will have to take over some tasks, which will raise their job demands. This may lead to productivity loss and additional pay costs (cf. Koningsveld & Mossink, 1997; Smulders, 1995). Considering this, it seems important to gain insight in the determinants of the onset and course of sickness absence.

Little is known on the course of long-term sickness absence, in particular on what happens within the first few months of the sick-leave episode. Consequently, little is known on the determinants of early return to work (RTW), which entails that there are little empirical-based practical guidelines that promote interventions aimed at the prevention of prolonged sick leave. The first four months of the sick leave seem important, because after this period the chances of RTW decrease (Schröer, 1993; SVr, 1994). In the present study we studied determinants of RTW within four months in employees who were sick-listed for at least six weeks. At the individual level, a difference can be made between work related (e.g. work content, social support at work) and non-work related (e.g. personality, physical condition, health) determinants of RTW after long-term sick leave (cf. Van der Stelt et al., 1996). In the present study we wanted to explore the effect of work characteristics on RTW because this category of determinants as yet has been given few attention with regard to RTW. Work characteristics were found to play an important role in the aetiology of health complaints (cf. Cooper & Payne, 1988; De Jonge & Kompier, 1997), as well as in the occurrence of sickness absence (Smulders & Nijhuis, 1999). Since RTW can be considered a measure of *recovery* from health complaints (cf. Lancourt & Kettelhut, 1992), work characteristics may also predict recovery as measured by RTW.

In the absence of a theoretical model that applies to the predictors of RTW, we took the work stress research tradition on the aetiology of health complaints as a starting-point. In the last two decades, the Demand-Control (DC) model (Karasek, 1979) induced a lot of research. In this model the stressful effects of high job demands can be buffered by high control over the work activities. Later support was added to the model because high support was thought to function as a buffer as well. In this form the model was called the Demand Control Support (DCS) model (Johnson & Hall, 1988; Karasek & Theorell, 1990). Specifically, the DCS model postulates two hypotheses. The first is that the

combination of high job demands, low control and low support predicts an adverse health state (i.e. the strain hypothesis). The second hypothesis is that the combination of high job demands, high control and high support predicts high work motivation and learning opportunities (i.e. the learning hypothesis). Over the last 30 years the DC(S) model has been used to predict a wide range of outcomes (see for reviews, De Jonge & Kompier, 1997; Van der Doef & Maes, 1999). In most of these studies, the strain hypothesis was tested (De Jonge & Kompier, 1997). In these studies, the empirical support for the predicted two- and three-way interactions between job demands and job control (DC model) or job demands, control and support (DCS model) is constrained while there is ample evidence on the main effects of these variables (De Jonge & Kompier, 1997; Van der Doef & Maes, 1999).

In previous prospective studies, the DCS variables appeared to predict future sickness absence occurrence and duration. In the Whitehall II study, low demands, low control and low support were predictive of the number of short and long absence spells (North et al., 1993; North et al., 1996). Nijhuis & Smulders (1996) found an effect of control on the number of absence days, but no effect of social support or job demands in a study among men. In a study of Vahtera et al. (1996) high demands were associated with a low and a high number of short absence spells for men and women respectively. No effect of demands was found for long spells. High control was associated with a low number of short and long absence spells. Supervisor support was only associated with short spells in women (Vahtera et al., 1996). In still another study among men, high job control and low job demands predicted a high number of absence days (Smulders & Nijhuis, 1999). Job demands and control had no effect on absence frequency (Smulders & Nijhuis, 1999). In a final prospective study it was found that control and co-worker support predicted the number of absence spells and days (Niedhammer et al., 1998). In some of the studies that were mentioned above, *low* demands predicted more absence spells or a longer absence duration (North et al., 1996; Vahtera et al., 1996; Smulders & Nijhuis, 1999). This effect of job demands is not in line with the strain hypothesis of the DC(S) model. Smulders and Nijhuis (1999) concluded in this regard that high job demands might also work as 'a pressure to attend'. Summarizing, as yet the literature on the influence of job demands and support on sickness absence is inconsistent. The effect of low control on high sickness absence rates is most clearly established (cf. Niedhammer et al., 1998). Finally, in the studies that were mentioned above, interaction terms between the DC(S) variables were not found significant (Nijhuis & Smulders, 1996; Niedhammer et al., 1998; Smulders & Nijhuis, 1999), or the exact form of the interaction was inconsistent across specific groups (North et al., 1996; Vahtera et al., 1996).

We know of only one study where the DCS-model was used to predict RTW after a long period of absence from work. Job demands, control and support were measured in a Dutch population of sick-listed employees, three to four months after the first day of the sick leave. RTW was measured again one year and two years after the start of the work incapacity. Low job demands were univariately associated with RTW, both full and partial, within the first three to four months of the sick leave (Van der Giezen et al.,

1996). Furthermore, employees who had partially returned to work reported a little more control in comparison to the employees who were not working at that time (Van der Giezen et al., 1996). One year after the start of the sick leave though, low job demands, high control and high support were univariately, significantly related to RTW (Van der Giezen et al., 2000). Two years after the start of the sick leave, high support predicted RTW in multivariate analyses (Cuelenaere et al., 1999). These results suggest that the DCS variables have differential effects on RTW depending on the time frame used. In this study however, the work characteristics were measured retrospectively, three to four months after the subject had reported ill. This holds the possibility that the measurement of the work characteristics was influenced by recall and by changes in the perception of the work situation during the sick leave.

We therefore further explore the DCS model as a predictor of RTW in a study population of long-term sick-listed employees. This study is carried out within the framework of a large-scale prospective study, i.e. the Maastricht Cohort Study. An advantage of this study framework is that we are able to include the work characteristics as measured before the onset of the sick leave episode. Three consecutive stages of RTW are investigated in the present study, which are determined four months after the first day of the sick leave: still being sick-listed, RTW with adjustments, and full RTW. The opportunity to RTW with adjustments with retention of sickness benefit, is embedded in the Dutch law. This option is meant to stimulate RTW for not fully recovered employees who are able to perform some tasks but who are not (yet) able to perform conform the usual productivity level in their job. The Dutch system therefore enables a gradual process of RTW (Cuelenaere, 2001). Employees may benefit from this option because of a positive effect of therapeutically working on recovery, or because they keep in touch with their colleagues and with developments at work. Employers may benefit from it because of less productivity costs and replacement costs.

Our research question is: 'What is the predictive value of the DCS variables in predicting RTW within four months, in a study population of employees sick-listed for six to eight weeks?' In line with the strain hypothesis of the DCS model, it is hypothesized that a work situation which is characterized by high strain, i.e. high job demands, low decision authority, low skill discretion and low support from colleagues and supervisor entail the greatest risk of prolonged sick leave and the lowest likelihood of full RTW. An explanation in line with the DCS model may be that a high strain work situation entails the most adverse health complaints, which in turn may be predictive of the longest sickness absence duration. Another explanation may be that employees experiencing similar health complaints in terms of severity or nature are more willing to early return to a low strain work situation than to a high strain work situation because of fear of recurring health complaints. Since return with adjustments may be considered a temporary and intermediate situation, it was expected that the biggest contrast in the size of the effects of the work characteristics for RTW would be found between the not working situation and the full RTW situation.

This study adds to the existing literature in several ways. To our knowledge, this is the first study on return to work in which work characteristics were measured *before* the onset of the sick-leave episode. Consequently, we got an unbiased perspective of the work characteristics that were included as predictors in this study. Furthermore, we controlled for potentially confounding effects of time out of work firstly by only selecting subjects with an equal sickness absence duration at the time of inclusion and secondly by stating RTW for everyone at the same point in time. In previous studies, time out of work was found to predict RTW (e.g. Gallagher et al., 1989; Lancourt & Kettelhut, 1992; Vendrig, 1999), and it was also shown that the nature of predictors, and the strength of the associations between predictors and outcome may differ by varying lengths of time out of work (Gallagher et al., 1989; Lancourt & Kettelhut, 1992; cf. Van der Giezen et al., 2000). Finally, by exploring the influence of work characteristics in predicting recovery from health complaints (i.e. as measured by RTW in this study), we investigate whether the influence of the DCS work characteristics in the aetiology of health complaints, can also be extended to the natural course of these health complaints.

Methods

Maastricht cohort study

The study population of long-term sick-listed employees was selected from the Maastricht Cohort Study (MCS) on fatigue at work (Kant et al., 2000). The MCS consisted of 12,140 employees at baseline (see table 1), recruited from 45 companies working in different occupational sectors. The cohort participants received self-administered questionnaires at the home address every four months for a period of three years (1998-2001). Once a year an extensive version of the questionnaire was filled out by cohort participants in which the work characteristics were measured. In this study we used demographic variables, which were measured in the baseline questionnaire. Moreover, the DCS variables were measured in the last extensive questionnaire, which was filled out prior to reporting ill (table 1).

Participating companies and institutions provided data on sick-listed employees. A subcohort of long-term sick-listed employees was followed by telephone interviews during their sick-leave. Inclusion criteria were that the subjects had to be sick-listed between six and eight weeks, that they spoke Dutch well enough to answer the questions and that they were on the sick list because of health complaints. Pregnant women were excluded from the study population because of the interference of the pregnancy and maternity leave with the length of the sick leave. The first standardized interview (T_1) took place two months after reporting ill. All subjects who met the inclusion criteria received a follow-up interview every two months and a final interview one year after reporting ill. In this study we only used the second standardized interview (T_2), which was held four months after reporting ill (table 1).

Table 1 Data collection.

Time table	Type of data	Subjects	Subjects not in the study	Data used in the study
May 1998	MCS Baseline: mailed questionnaires	12,140		Demographics
May 1998 or May 1999	Last MCS questionnaire before onset sick leave episode			Demand Control Support variables
January 1999 to January 2000 ↓	Selection of long-term (6-8 weeks) work incapacitated based on administrative data	795		
T ₁ : ~2 months after onset of the sick leave ↓	Telephone interview	455	Excluded n=69 Not reached n=237 Non-response n=34	
T ₂ : ~4 months after the start of the sick leave	Telephone interview	398	Not reached n=54 Deceased n=1 Non-response n=2	Return to work (outcome)

Study population

Between January 1999 and January 2000 a total of 795 employees who were sick-listed for six to eight weeks were selected from the Maastricht Cohort Study (table 1). Of these 795 subjects 237 subjects could not be reached for the first telephone interview. This was because their phone number was unknown or because they did not answer the phone in the two weeks in which we tried to reach the subject. A total of 69 employees did not meet the selection criteria and 34 did not want to participate due to the stress that would be caused by participation, due to the seriousness of the illness, because they were not interested, had no time or because of privacy reasons. To investigate the presence of selection bias the net study population at T₀ (n=455) was compared to the nonrespondents (n=34) and the employees who could not be reached in time (n=237). The group that could not be reached and the nonrespondent group did not differ from each other on the research variables. Therefore, it was permitted to consider the nonrespondents and the subjects who could not be reached as one group and to compare this group (n=271) with the net study population (n=455). Univariate analyses showed that respondents were older (i.e. M=42.9, sd=8.61 vs. M=39.8, sd=9.47, p=.000), and that there were more males in the respondent group (70.0% versus 57.6%, p=.001). No differences between these groups were found for the scores on the independent work characteristics. Despite these differences in age and gender, we believe that the variety in background characteristics in the respondent group was still high enough to be able to answer our explanatory research question.

Four months after reporting ill, at T_2 , the loss to follow-up was caused by not being able to reach the participant within two weeks ($n=54$), non-response ($n=2$) and death ($n=1$). Only subjects with a valid T_1 and a valid T_2 interview were included in the analysis ($n=398$). No differences on the research variables were found between the drop-outs ($n=57$) and our study population ($n=398$). Therefore, it was concluded that no selection problems had occurred from the follow-up non-response.

Measures

Return to work

RTW was measured four months after reporting ill in a telephone interview by the question "Are you working at present?". Those who returned to work were asked whether adjustments in the work had been realized. Full RTW was operationalized in this study as working without adjustments or with permanent adjustments made to the work situation. The three categories of RTW, i.e. not working, RTW with adjustments and full RTW were analyzed separately because these were considered as three separate, consecutive stages of recovery with potential differences in nature and strength of predictors.

Demand Control Support variables

The DCS variables were measured with a Dutch translation of Karasek's Job Content Questionnaire (Houtman, 1995; JCQ; Karasek, 1985) that was included in the MCS on fatigue at work (table 1). For each subject of the sick-listed study population the most recent MCS measurement of the JCQ prior to reporting ill was used (May 1998 or May 1999). The mean time between the measurement of the work characteristics and reporting ill was 31 weeks ($sd=17$). *Psychological job demands* refer to work load and work pressure (5 items, range 12-48, $\alpha = .68$). Decision latitude measures the amount of control and is a combination of two theoretically distinct concepts: *decision authority* (3 items, range 12-48, $\alpha=.75$) and *skill discretion* (6 items, range 12-48, $\alpha=.67$). Decision authority is operationalized as the worker's authority to make decisions on the job and skill discretion is operationalized as the breadth of skills used by the worker on the job and task variety. Because of recent criticism of the combination of these concepts because of the substantive differences between these two scales, we included the separate concepts of skill discretion and decision authority (e.g. De Jonge & Kompier, 1997; De Rijk et al., 1998). Social support at work was measured by two scales, i.e. *supervisor support* (4 items, range 4-16, $\alpha=.90$) and *co-worker support* (4 items, range 4-16, $\alpha=.82$). Items in both scales reflect socioemotional support and instrumental support (Karasek et al., 1998). All items which were included in the present study were scored on a four-point Likert scale, ranging from 'strongly disagree' to 'strongly agree'. Sum scores were calculated according to the instructions in revision 1.1 of the JCQ user's guide (Karasek, 1985). A higher score corresponds with more demands, more skill discretion, more decision authority, more supervisor support and more co-worker support.

Demographic variables

The demographic variables gender and age, which were measured in the baseline MCS questionnaire, were included in the study as potential confounders (table 1).

Statistical analysis

We used the statistical package SPSS version 10.0.7. for the statistical analyses. Logistic regression analyses were executed for each of the combinations of employment statuses: working with adjustments versus not working, working without adjustments versus not working, and working without adjustments versus working with adjustments. The buffer effect of control and support for high job demands was tested by including multiplicative terms in the regression equations (i.e. decision authority * job demands, skill discretion * job demands, co-worker support * job demands, supervisor support * job demands). Confounders, direct effects and interaction terms were successively entered in three steps. The two-way interaction terms were tested one by one in separate analyses. The interactive terms were not included all at once because the effects of the separate interaction terms might confound each other. Before entering into the logistic regression all psychosocial job characteristics were divided by the standard deviation of their scale, to make the interpretation of the odds ratios (ORs) easier. For the same reason age was divided by 10 before entering it in the regression. Because of the exploratory nature of the study, alpha was set at $\alpha=.10$ to indicate significant effects. We first compared RTW with adjustments, and in a next analysis full RTW, to the category of not working four months after reporting ill. The latter group was taken as a reference (OR=1) in order to be able to compare the results across the consecutive stages of RTW. Second, we investigated the predictors of RTW without adjustments, thereby taking the group working with adjustments as a reference (OR=1). By including the latter analysis, the expected differences in predictors of both categories of RTW could be made more explicit and tested on their statistical significance.

Results

Descriptives

The mean age of the 398 subjects was 42.7 years (sd= 8.52), ages ranging from 19-60 years. The total population consisted of 70.8% male subjects. The portion of subjects with a low education (i.e. primary school or lower vocational education) was 32.7%, 49.3% fell in the middle category and 17.9% fell in the highest category of education (i.e. upper vocational education or university). Four months after reporting ill 69.6% (n=277) had returned to work, while 30.4% (n=121) was not working. Of those who had returned to work 170 were working with adjustments made to the work or work conditions (42.7% of total). An additional 89 were working without adjustments. Furthermore, 18 persons were working with permanent adjustments, which were mainly technical adjustments of the work place. The latter two groups were included in the analyses as one group (full RTW). This was permitted because subjects with permanent adjustments were not in a transitional stage comparable to the 170 subjects working with temporary adjustments.

Furthermore, the groups working without adjustments and the group working with permanent adjustments did not differ on any of the research variables.

Predictors of RTW: RTW with adjustments versus not working

The results of the analysis on the predictors of RTW with adjustments are presented in table 2 (columns 4 and 5). A higher degree of skill discretion appeared to predict working with adjustments (OR=1.36; 90% CI=1.04-1.79, p= .063). However, in the third step of the regression analysis in which the interaction terms were tested, it appeared that high skill discretion in combination with high job demands had a positive effect on RTW with adjustments (OR=.83, 90% CI=.69-.99, p=.086). Thus, the additive effect of skill discretion on RTW with adjustments appeared to be surpassed by the moderating effect of job demands on this relation. To illustrate this finding, the total scores of these work characteristics were dichotomized at the median (high/low score). In descriptive terms then, the highest success rate (i.e. in terms of working with adjustments as opposed to not working) was found in subjects who reported high job demands and high skill discretion (i.e. 65.6%) and the lowest success rate when low job demands and low skill discretion were reported (i.e. 52.0%).

Table 2 Prospective factors for RTW with adjustments (columns 4 and 5) and full RTW (columns 6 and 7) in comparison to not working at T₂: odds ratios and 90% confidence intervals

Step	Variable	Not working ^d	RTW with adjustments (OR)	90% CI	Full RTW (OR)	90% CI
1	demographic covariates ^a					
	men ^c	1	1.39	.88-2.20	1.66	.99-2.79
	Age ^b	1	.99	.77-1.27	.90	.69-1.19
2	DCS variables ^a					
	job demands ^c	1	1.21	.97-1.50	.94	.73-1.20
	supervisor support ^c	1	1.17	.93-1.48	1.40	1.08-1.83
	co-worker support ^c	1	1.01	.81-1.27	1.04	.81-1.32
	skill discretion ^c	1	1.36	1.04-1.79	1.13	.82-1.56
	decision authority ^c	1	.83	.63-1.09	.87	.62-1.20
3	interaction terms ^a					
	skill discretion * job demands	1	.83	.69-.99		

^a step 1: crude odds ratios for demographic confounders; step 2: work characteristics presented adjusted for demographic confounders; step 3: interaction term adjusted for work characteristics and demographics

^b 10-point increase

^c increase per standard deviation

^d reference category is not working

Predictors of RTW: Full RTW versus not working

The results of the analysis on the predictors of full RTW are presented in table 2 (columns 6 and 7). In the second step of the analyses, after having controlled for the DCS variables, being a man was found to be slightly more predictive of full RTW as compared to not working than being a women (OR=1.75; 90% CI=.92-3.36, $p=.090$; specific data not shown). Furthermore, high supervisor support predicted full RTW (OR=1.40, 90% CI=1.08-1.83, $p=.034$). Interactive effects between the DCS variables were not found.

Predictors of RTW: Full RTW versus working with adjustments

In table 3 it is shown that low job demands predicted full RTW while high job demands predicted RTW with adjustments (OR=.75, 90% CI=.59-.96, $p=.057$). Interactive effects between the DCS variables were not found.

Table 3 Prospective factors for full RTW in comparison to RTW with adjustments at T₂: odds ratios and 90% confidence intervals

Step	Variable	RTW with adjustments ^d	Full RTW (OR)	90% CI
1	demographic covariates ^a			
	men ^c	1	1.22	.74-2.02
	age ^b	1	.89	.69-1.16
2	DCS variables ^a			
	job demands ^c	1	.75	.59-.96
	supervisor support ^c	1	1.18	.92-1.51
	co-worker support ^c	1	1.05	.81-1.36
	skill discretion ^c	1	.79	.59-1.05
	decision authority ^c	1	1.05	.80-1.39

^a step 1: crude odds ratios for demographic confounders; step 2: work characteristics presented adjusted for demographic confounders

^b 10-point increase

^c increase per standard deviation

^d reference category is RTW with adjustments

Discussion

The research question of this study focused on the prospective value of the DCS work characteristics in predicting RTW four months after the onset of the sick leave episode. Specifically, our hypothesis was that high job demands, low job control and low support would obstruct (full) RTW. We expected to find differences in the strengths of the effects of these work characteristics on our three outcome measures, which included not working, RTW with adjustments and full RTW. Indeed, results differed by outcome measure. First, we found a positive effect of skill discretion on working with adjustments as compared to not working. Moreover, this effect was most apparent in case of high job

demands. In other words, an interactive effect of high demands in combination with high skill discretion was found predictive of working with adjustments. Second, supervisor support appeared to discriminate between not working and full RTW. Third, low job demands appeared predictive of full RTW as compared to working with adjustments.

Our hypothesis with regard to RTW was based on the strain hypothesis of the DC(S) model. We hardly found any evidence on this assumption. This conclusion can be explained as follows. Only one out of twelve or 8% of the DC(S) interactions we investigated was found significant in the prediction of RTW. Furthermore, the interactive effect was marginally significant and it was only found predictive of one out of three outcome measures. Moreover, no interaction was found for the combination of job demands and decision authority, or for the combination of job demands and social support. Thus, statistically the results do not provide strong support for the strain hypothesis. Moreover, the direction of the interactive effect was unexpected. Not low job demands in combination with high control predicted RTW with adjustments as compared to not working, but *high* job demands in combination with high control. Though not in line with the strain hypothesis, this finding is in line with the learning hypothesis of the DC model. According to the learning hypothesis, motivation would be highest in jobs characterized by high job demands and high control (Karasek, 1979). Thus, in terms of the DC(S) model, the effect would be interpreted by stressing the importance of the role of motivation in RTW. Enough variety in the job (skill discretion) may however not (only) function as an additional motivator next to high job demands, but enough job variety may be a precondition in a highly demanding work situation to make the necessary work adjustments that are needed to get an employee back who is not yet able to achieve a full productive work status. Though not in combination with high job demands, Van der Giezen et al. (1996) also found that a slightly higher score on job control was found in the group that had returned to work with adjustments.

Considering all three outcome categories together, the likelihood that employees with high demands had fully returned to work was lowest. This was in line with our expectations, and may be explained by assuming that high demands induce the most adverse health complaints and the longest period to recover. Or, it may be that high demands induce the greatest fear of full RTW. This may be fear of recurring, or worsening of health complaints in case one has just or not completely recovered from the health complaints for which one has called in sick. Van der Giezen et al. (1996) also found a univariate association between high job demands and not working. However, though a trend was found that employees with high job demands were more likely to having not returned to work in comparison to having fully returned to work, we also found a trend that employees with high job demands were more likely to having returned to work with adjustments in comparison to having not returned to work. The latter trend was not found in the study of Van der Giezen et al. (1996). The partially contradictory results we found with regard to RTW with adjustments may originate from different sample characteristics. The present study included all kinds of diagnoses and a heterogeneous population with regard to educational level, while the study of Van der Giezen et al.

(1996) included only low back pain patients of whom the majority only had a lower educational level. These characteristics may have affected the possibilities to return to work with adjustments (e.g. Gründemann & Nijboer, 1998; Van Lierop, 2001), particularly in case of high job demands, or these characteristics may have affected the presence of 'a pressure to attend' or 'feelings of personal importance' (cf. Smulders & Nijhuis, 1999; Vahtera et al., 1996). Furthermore, work characteristics in the study of Van der Giezen et al. (1996) were measured 3-4 months *after* the onset of the sick leave, which, as mentioned in the introduction, may have affected the results.

Supervisor support appeared to discriminate between not working and full RTW. Moreover, there appeared to be a trend of increasing supervisor support while looking at the successive categories of not working, RTW with adjustments and full RTW. Thus, it seemed that more supervisor support entailed more recovery. The effect of supervisor support may also be explained as working as a pressure to attend (cf. Smulders & Nijhuis, 1999), but it may also be that employees who report more support before the onset of the sick leave, may also get more support during the sick leave in terms of for example appreciative or emotional support (e.g. visits, telephone contacts, gifts), or instrumental support (e.g. help to realize adjustments or solving work-related problems) by which early RTW is facilitated.

On the basis of the differential predictors that were found for the three categories of early RTW, it was concluded that it is useful to make a distinction between these groups in future studies. The results of the present study suggest that work characteristics have predictive value for RTW in this stage of the sick leave, even though effects sizes were small. Future studies will have to reveal whether the found relationships can be extended to later stages of the sick leave. Because of the exploratory nature of the present study, we could only speculate on the specific mechanisms by which work characteristics affect RTW. In depth interviews or investigating a broader variety of individual determinants of RTW (e.g. personality, health) may reveal a more complete picture on the determinants of early RTW and more insight in the relationships between different (categories of) predictors (cf. Van der Giezen et al., 2000). In addition, the DCS model has been criticized on its simplicity (De Jonge & Kompier, 1997). It may be that more specific work characteristics (De Jonge & Kompier, 1997; De Jonge et al., 2000) or job-related attitudes like job satisfaction or commitment (cf. Van der Giezen et al., 2000; Vendrig, 1999) that were not included in the present study have stronger predictive value for RTW. Next to these background variables, process variables like socio-medical guidance or help-seeking behaviour may be important predictors of early RTW (cf. Smulders, 1980). In general, it seems clear that RTW needs more attention in future research. This seems particularly true for early RTW, considering the little knowledge on this subject thusfar. More knowledge on early return to work entails opportunities to derive guidelines for the prevention of the high social and financial costs of prolonged sick leave.

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6

Fatigue as a predictor of return to work in different diagnosis groups

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Submitted for publication

Abstract

Thus far, the effect of fatigue on return to work (RTW) was not investigated in a structured manner across diagnosis groups. The present study focuses on the effect of fatigue on early RTW, within a population of long-term sick-listed employees. It was hypothesized that higher fatigue would obstruct RTW with adjustments, as well as full return to work. This hypothesis was investigated in the whole study population as well as within three diagnosis groups: employees suffering from musculoskeletal, mental and other physical illnesses. Higher fatigue appeared to obstruct full RTW within the group that initially had returned to work with adjustments, but only within the group with musculoskeletal illnesses. In this way, a higher fatigue level extended the period that an employee was partially sick-listed due to musculoskeletal complaints. Results in the group with 'other' physical illnesses were unclear due to low numbers.

Introduction

In the Netherlands, as in other industrialized countries, the costs of sickness absence and disability are huge (Koningsveld & Mossink, 1997; Schaufeli & Enzmann, 1998). Most importantly for the individual, long-term sickness absence may have negative consequences such as loss of daily structure and isolation. Long-term sickness absence and disability however also bring high costs for the employer and society. In the Netherlands, the employer is responsible for the sickness benefits during the first year of the sick leave. Subsequently, the employee gets a medical and vocational examination¹. If, based on this examination, the employee is considered (partly) disabled for work, a disability pension is awarded which is paid by society. The study of predictors of early return to work (RTW) gives insight in the disability process and provides guidelines for early secondary prevention activities that may help lower the costs for the individual, the employer and society (Shrey & Lacerte, 1997).

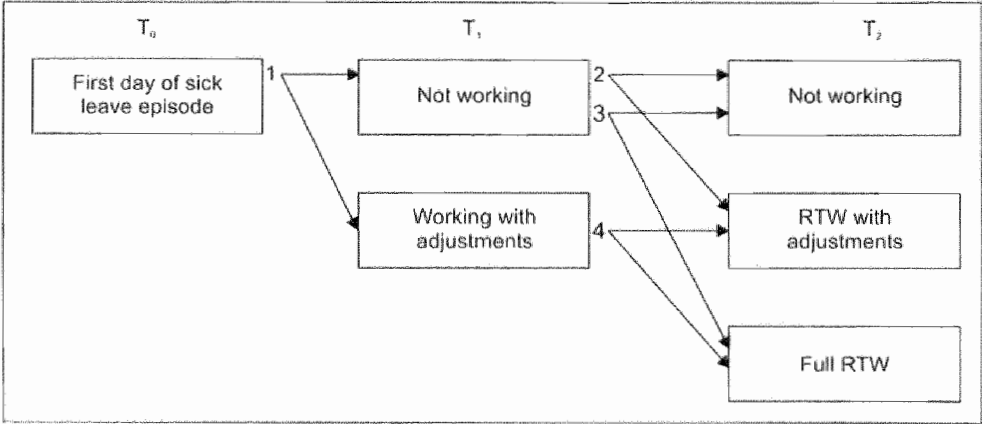
Previous studies on return to work (RTW) have investigated the effects of health indicators (Shaw & Polatajko, 2002). These health indicators may be more or less directly related to the severity of the health condition for which one is sick-listed. Worse scores on physical complaints, subjective disability, general health, fatigue, depression and pain intensity were found predictive of lack of RTW within a variety of diagnosis groups (Lancourt & Kettelhut, 1992; Linder et al., 2000; Söderman et al., 2003; Spelten et al., 2003; Van der Giezen et al., 2000). Russo et al. (1998) found effects of *changes* in physical and psychiatric health indicators on RTW (Russo et al., 1998). Some studies in low back pain patients indicated that the role of illness severity in the RTW process may be stage-specific: illness severity may be more important in predicting the duration of disability in the first month than in later phases of the disability process (Dasinger et al., 2000; Krause et al., 2001). Throughout the whole sick leave episode, it however remains an important factor in the prediction of RTW (Franché & Krause, 2002). Some authors have argued that subjective health indicators may be even more important as a predictor of RTW and disability than objective health indicators (Månsson & Råstam, 2001; Vendrig, 1999). Despite comparison difficulties due to variation in time off work, follow-up period, legal system and regulations with regard to workers compensation, operationalisations and variety in (combinations of) predictors across studies, the reported studies seem to confirm that worse health has a negative effect on RTW.

The present study focuses on fatigue as a predictor of RTW. Fatigue is a common, non-specific and disabling complaint (Sharpe & Wilks, 2002). It is found prevalent in clinical populations (Chen, 1986), in the general population (Loge et al., 1998; Pawlikowska et al., 1994), in general practice attendants (David et al., 1990; Hickie et al., 1996; Kroenke et al., 1988) and among employees (Bültmann et al., 2002b). Fatigue is an important symptom of chronic job stress and burnout. Chronic job stress and burnout fall in the

¹ These were the statutory regulations at the time of the data collection for the present study. As from 2004, employers even have to compensate the employee for the first two years of the sick leave. Subsequently, eligibility for a disability pension is determined.

diagnosis category 'exogenous reaction'. This diagnosis category is responsible for a big part of the total number of disability recipients on mental grounds in the Netherlands (Hoogduin et al., 1999; Veerman et al., 2001). Hence, fatigue may be an important precursor of prolonged sickness absence and subsequent work disability on grounds of stress-related mental health complaints (cf. Van der Klink, 1993). Since fatigue is a symptom of, and accompanies a lot of other health complaints, it may also be a precursor or correlate of these other health complaints. Moreover, within employees who are sick-listed due to these other health complaints, fatigue may obstruct RTW. Since fatigue may play differential roles within different diagnosis groups, its effect on RTW may also differ across diagnosis groups. Since this was not investigated as yet in a structured manner, the aim of the present study was to investigate whether fatigue is predictive of RTW in specific diagnosis groups. The effect of fatigue in specific diagnosis groups was compared with its effect in the whole study population in order to state the influence of diagnosis-specific conditions on the results of the analyses in the whole study population. Further, there is little insight in early RTW patterns across diagnosis groups. Therefore, in addition to the explanatory analyses, work resumption patterns were stated for the whole study population as well as within diagnosis groups.

Figure 1 Work resumption patterns



The above-stated led to the following overall research objectives: 1) To investigate the work resumption patterns in the first four months of the sick leave 2) To investigate the relationship between fatigue and RTW. RTW was stated at different lengths of follow-up: close after inclusion (T₁) and four months after the onset of the sick leave (T₂).

The second research objective is specified in the following research questions:

- 1) Does a higher fatigue level obstruct RTW with adjustments at T_1 ?² (figure 1, path 1)
- 2) Does a higher fatigue level, in a population not working at T_1 , obstruct the transition to RTW with adjustments between T_1 and T_2 ? (figure 1, path 2)
- 3) Does a higher fatigue level, in a population not working at T_1 , obstruct the transition to full RTW between T_1 and T_2 ? (figure 1, path 3)
- 4) Does a higher fatigue level, in a population working with adjustments at T_1 , obstruct the transition to full RTW between T_1 and T_2 ? (figure 1, path 4)

These relationships were investigated in the whole study population as well as within the three diagnosis groups with mental, musculoskeletal and other physical health complaints.

Methods

Maastricht Cohort Study

The study population of long-term sick-listed employees was selected from the Maastricht Cohort Study (MCS) on fatigue at work (Kant et al., 2000). The MCS consisted of 12,140 employees at baseline (May 1998; see table 1), recruited from 45 companies working in different occupational sectors. The cohort participants received self-administered questionnaires at the home address every four months for a period of three years (1998-2001). Cohort participants filled out once a year an extensive version of the questionnaire including work characteristics. In the present study, the most recent extensive MCS measurement prior to reporting ill was used for each subject, including fatigue and the potential confounding work characteristics (May 1998 or May 1999; see table 1). The mean time between this measurement and reporting ill was 31 weeks ($sd=17$). In addition to work characteristics, age and gender were included as potential confounders. Age and gender were measured in the MCS baseline questionnaire (table 1).

Participating companies and institutions provided data on sick-listed employees. A cohort of long-term sick-listed employees was followed by standardised telephone interviews during their sick leave. Inclusion criteria were that the subjects had to be sick-listed between six and eight weeks, that they spoke Dutch well enough to answer the questions and that they were on the sick list because of health complaints. Pregnant women were excluded from the study population because of the interference of the pregnancy and maternity leave with the length of the sick leave. All subjects who met the inclusion criteria received a follow-up interview every two months and a final interview one year after reporting ill. In this study we only used the first interview (T_1), which took

² Considering the relatively short time period between inclusion and the first interview, variety in work status at T_1 was expected to be low. This in combination with the fact that differential predictors may exist for RTW with adjustments and full RTW, made us decide to only investigate the subgroup RTW with adjustments at T_1 in comparison with not working at T_1 .

place about two months after the onset of the sick leave, and the second interview (T₂), which was held about four months after reporting ill (table 1).

Study population

From January 1999 to January 2000 a total of 795 employees who were sick-listed for six to eight weeks were selected from the Maastricht Cohort Study (table 1). Of these 795 subjects 237 subjects could not be reached for the first telephone interview. This was because their phone number was unknown or because they did not answer the phone in the two weeks in which we tried to reach the subject. A total of 69 employees did not meet the selection criteria and 34 did not want to participate due to the stress that would be caused by participation, due to the seriousness of the illness, because they were not interested, had no time or because of privacy reasons. A nonresponse analysis revealed that respondents were older and more often male, but differences were small. No differences between respondents and nonrespondents were found for fatigue or work characteristics. It was concluded that variety in background characteristics in the respondent group was still high enough to be able to answer our explanatory research question.

Table 1 Data collection

Time table	Type of data	Subjects	Subjects not in the study	Data used in the study
May 1998	MCS Baseline: mailed questionnaires	12,140		Demographics
May 1998 or May 1999	Last MCS questionnaire before onset sick leave episode			Fatigue and work characteristics
January 1999 to January 2000 ↓	Selection of long-term (6-8 weeks) work incapacitated based on administrative data	795		
T ₁ : ~2 months after onset of the sick leave ↓	Telephone interview	455	Excluded n=69 Not reached n=237 Non-response n=34	Return to work (outcome)
T ₂ : ~4 months after onset of the sick leave	Telephone interview	398	Not reached n=54 Deceased n=1 Non-response n=2	Return to work (outcome)

Four months after reporting ill, at T₂, the loss to follow-up was small (57/ 455) and almost exclusively caused by not being able to reach the participant within two weeks. Only subjects with a valid T₁ and a valid T₂ interview were included in the analysis (n=398). No differences on the research variables were found between the dropouts (n=57) and our study population (n=398). Therefore, it was concluded that no selection problems had occurred from the follow-up non-response. Detailed information on the initial and follow-up nonresponse analysis with regard to the telephone interviews was given elsewhere (Janssen et al., 2003a).

Diagnosis groups

Three diagnosis groups were discerned. The categorization of employees was done according to the International Classification of Primary Care (ICPC, Lamberts & Wood, 1987) on the basis of self-reported health complaints and diagnosis, as stated before or after the onset of the sick leave. The categorization was independently executed by two researchers. In case of differing opinions, the opinion of a third researcher was decisive if consensus could not be reached.

The majority of employees suffering from '*mental health complaints*' had a mixture of health complaints including strain, fatigue, depressive or burnout complaints, and difficulties concentrating. Some had minor psychosomatic complaints such as high blood pressure or minor intestinal or stomach complaints. Most employees in the group '*musculoskeletal*' had back problems but other musculoskeletal problems were included as well. The group '*other physical health complaints*' mainly included diseases of the respiratory system, diseases of the circulatory system, diseases of the neurological system and diseases of the digestive system. The other employees within this group had a variety of other physical health complaints.

About 85% of employees within the groups '*mental*' and '*musculoskeletal*' had health complaints that could be attributed to a single diagnosis category. The rest had co morbid health complaints that did not fit in with the main diagnosis category that person was classified in. It is known that mental health complaints and musculoskeletal health complaints may be intertwined (Veerman et al., 2001). In the present study the two diagnosis groups of '*mental*' and '*musculoskeletal*' were separated as much as possible. In this way, the contrast between these groups was maximized and homogeneity within groups assured. Consequently, employees who reported vague diagnoses such as fibromyalgia, Repetitive Strain Injury and whiplash injury were excluded. Employees with co morbid clinical pictures being a combination of mental and musculoskeletal complaints were also excluded. After application of these exclusion criteria, the group '*mental*' included 101 employees, the group of '*musculoskeletal*' consisted of 156 employees, and the group '*other physical health complaints*' consisted of 100 employees.

Measures

Return to work

RTW was measured two and four months after reporting ill in a telephone interview. A distinction was made between the RTW outcomes being sick-listed, RTW with adjustments, and full RTW, since predictors may be differentially predictive of these outcomes (Janssen et al., 2003a). Full RTW was operationalised in this study as working without adjustments or with permanent adjustments made to the work situation.

RTW at two months after the onset of the sick leave (T_1)

The first outcome was operationalised by contrasting the group that had returned to work with adjustments at T_1 with the group that was not working at T_1 . The latter group was taken as the reference category.

RTW between the second (T_1) and the fourth month (T_2) after the onset of the sick leave

The second outcome was stated by focusing on the group that was not working at T_1 . Within this population, the group that still had not resumed work at T_2 was taken as the reference category and contrasted with the group that had returned to work between T_1 and T_2 , i.e. subsequently with the group that had returned with adjustments and with the group that had fully returned to work between T_1 and T_2 .

The third outcome was stated by focusing on the group with work status RTW with adjustments at T_1 . The group within this population that was still working with adjustments at T_2 was taken as the reference category and contrasted with the group that had fully returned to work between T_1 and T_2 .

Fatigue

In this study, fatigue was measured with the Checklist Individual Strength (CIS). The CIS contains 20 items that are scored on a 7 point-Likert scale, which ranges from very often (1) to rarely or never (7). It is a multidimensional self-report questionnaire that covers the following subscales: subjective fatigue (i.e. eight items on somatic symptoms and general feelings of fatigue), reduction in motivation (four items), reduction in concentration (five items) and reduction in activity (three items). Items do not refer to the work situation but are stated in general terms. The reference period of the scale is the last two weeks. The CIS was developed for clinical populations, in particular for people suffering from the chronic fatigue syndrome (Vercoulen et al., 1996a; Vercoulen et al., 1996b) but was also validated in the working population (Beurskens et al., 2000). In the present study we used the total fatigue score, which was based on all 20 items ($\alpha=.94$ within the whole study population). Within diagnosis groups, reliability indices for the CIS ranged from $\alpha=.91$ (group other physical health complaints) to $\alpha=.94$ (groups musculoskeletal and mental health complaints). The response scale ranged from 20-140. A higher score means a higher level of fatigue.

Potential work-related confounders

Work characteristics may confound the relationship between fatigue and RTW. This is because work characteristics were found to be related with the onset, and to a lesser

extent with the course of fatigue (Bültmann et al., 2002a; Janssen et al., submitted). Moreover, in a previous study within the same study population as was used in the present study, it was found that a selection of some work characteristics had a small effect on RTW (Janssen et al., 2003a). These three work characteristics, i.e. skill discretion, psychological job demands and supervisor support, were included as potential confounders. These work characteristics were measured with a Dutch translation of Karasek's Job Content Questionnaire (JCQ; Karasek, 1985; Houtman, 1995) that was included in the MCS on fatigue at work. *Psychological job demands* refer to work load and work pressure (five items, range 12-48, $\alpha=.68$). *Skill discretion* (six items, range 12-48, $\alpha=.67$) is operationalised as the breadth of skills used by the worker on the job and task variety. *Supervisor support* (four items, range 4-16, $\alpha=.90$) contains items on socioemotional support and instrumental support (Karasek et al., 1998). Within diagnosis groups, reliability indices ranged from $\alpha=.67$ (group mental health complaints) to $\alpha=.71$ (group musculoskeletal) for psychological job demands; from $\alpha=.57$ (group musculoskeletal) to $\alpha=.73$ (groups mental and other physical health complaints) for skill discretion and from $\alpha=.86$ (group other physical health complaints) to $\alpha=.91$ (group mental health complaints) for supervisor support.

All items of the work characteristics were scored on a four-point Likert scale, ranging from 'strongly disagree' to 'strongly agree'. Sum scores were calculated according to the instructions in revision 1.1 of the JCQ user's guide (Karasek, 1985). A higher score corresponds with more demands, more skill discretion and more supervisor support.

Statistical analysis

We used the statistical package SPSS version 10.0.7 for the statistical analyses. Logistic regression analyses were executed for each of the combinations of the work statuses as described earlier. The effect of fatigue on RTW after long-term sick leave was investigated while taking into account the potential confounding influence of demographic characteristics (in a first step of the analyses) and work characteristics (in a second step of the analyses). Before entering into the logistic regression, the work characteristics and fatigue were divided by their standard deviation, to make the interpretation of the odds ratios (ORs) easier. For the same reason age was divided by 10 before entering it in the regression. Alpha was set at $\alpha=.05$ to indicate significant effects.

Results

Preliminary analyses

Descriptives of fatigue, work characteristics and sociodemographics for the total study population as well as within the three diagnosis groups are depicted in table 2. A one-way ANOVA analysis was conducted to detect significant differences between diagnosis groups. It appeared that the group with mental health complaints had a significantly higher level of fatigue than the groups with musculoskeletal and other physical health

complaints. The lowest level of fatigue was found in the group with musculoskeletal health complaints. The diagnosis groups did not significantly differ in scores on work characteristics or demographics. Since differences in fatigue may be related to differences in general health, some data are given on general health in table 2. Employees were asked about their general health status (cf. Aaronson et al., 1998) and if they suffered from a (physical or psychological) long-term illness. Differences across diagnosis groups were not significant.

Table 2 Descriptives for the whole study population (second column) and across diagnosis groups: means (SD) or percentages. In the last column, results are shown of the comparison of the descriptives across diagnosis groups.

Variable	Whole study population n=398	Other health complaints n=100 (1)	Musculo- skeletal n=156 (2)	Mental n=101 (3)	ANOVA (Scheffé) /Chi square ¹
Fatigue	66.36 (25.00)	65.00 (22.09)	62.38 (26.31)	73.75 (22.44)	2 vs. 3 p=.002 1 vs. 3 p=.040
Job demands	33.69 (5.52)	33.14 (5.11)	33.32 (5.85)	34.72 (5.37)	
Skill discretion	34.92 (5.76)	35.32 (5.97)	34.34 (5.69)	36.05 (5.94)	
Supervisor support	9.94 (2.63)	10.36 (2.47)	10.03 (2.59)	9.57 (2.78)	
Age	42.69 (8.52)	44.89 (8.57)	42.38 (8.14)	42.17 (8.42)	
Gender (% men)	70.8	74.7	70.5	76.2	
General health (%)					
Very good-Excellent	15.6	15.0	17.9	12.9	
Good	54.5	49.0	55.1	61.4	
Moderate-Bad	29.9	36.0	26.9	25.7	
Long-term illness (%)	45.0	46.0	46.2	37.6	

¹ Group comparisons are shown if means are significantly different at p<.05

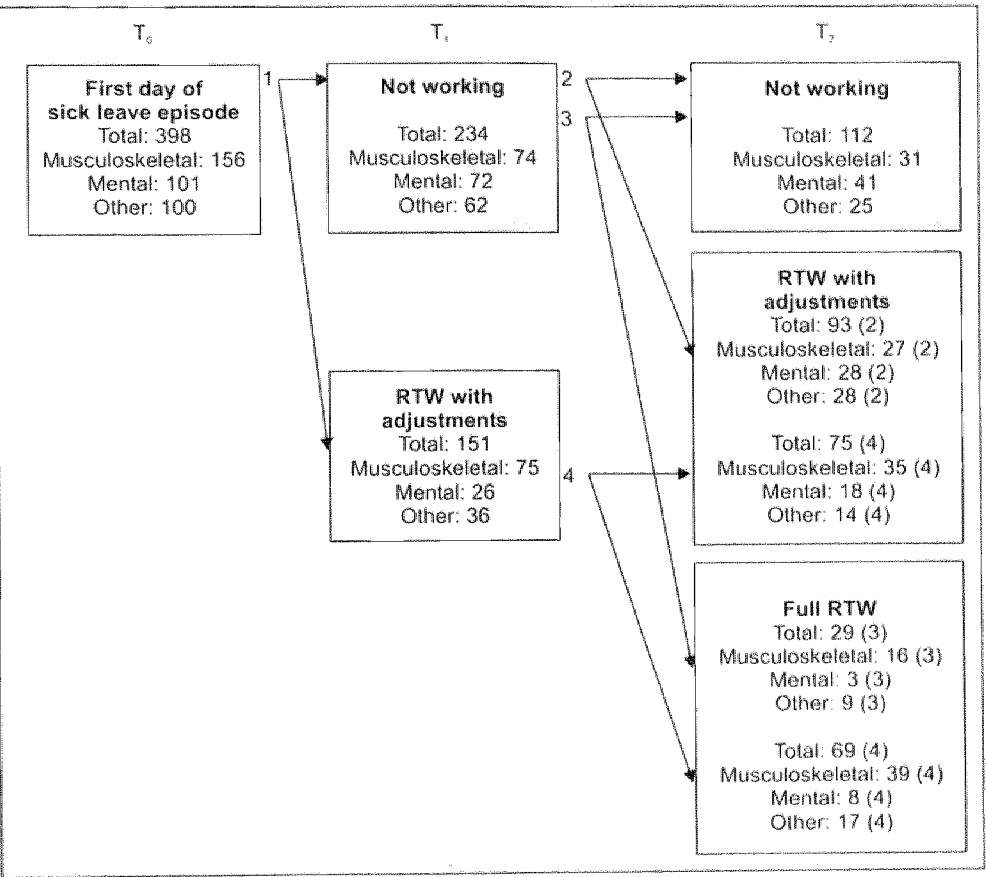
Next, the results of the descriptive analyses on work resumption patterns and the results of the logistic regression analyses on the effect of fatigue on RTW are firstly described for the whole study population. Subsequently, the results will be described of the analyses within diagnosis groups.

Work resumption patterns

In figure 2, a flowchart is given of the work resumption patterns that were observed in the total study population. It appeared that about half (52.1%) of the employees who were not working at T₁ had returned to work between T₁ and T₂. Most of these employees returned to work with adjustments. In general, only a small part of those who returned to

work during follow-up did this without the intermediate work status of RTW with adjustments. Instead, the majority returned to work with adjustments firstly (61.3% of the whole study population). Of all long-term sick-listed employees, about one quarter had fully returned to work within four months.

Figure 2 Work resumption patterns for total group and within diagnosis groups.
Numbers of employees are given (numbers 1-4 correspond with the research questions).



RTW with adjustments vs. not working at T₁

In the second and third column of table 3, the results are depicted of the logistic regression analysis on the outcome RTW with adjustments vs. not working at two months after the onset of the sick leave. Fatigue had no significant effect in the first or second step of the analyses. After controlling for fatigue and work characteristics, men had a higher likelihood of having returned to work with adjustments in comparison with women (OR=2.48, 95% CI 1.45-4.25, p=.001). Younger employees had a higher

likelihood of having returned to work with adjustments in comparison with older employees (OR=.76, 95% CI .57-1.00, p=.05).

Full RTW or RTW with adjustments at T₂ vs. not working at T₂, within the population not working at T₁

The numbers of subjects in some categories of the outcome variables were low if RTW with adjustments and full RTW were separately analysed. Although this would not be a problem in analyses within the whole study population, this would be problematic within diagnosis groups. By combining the two groups of RTW with adjustments and full RTW we raised the number of subjects in the analyses, which may give a more reliable picture. In the fourth and fifth column of table 3, the results are shown of the analysis with predictors of RTW between T₁ and T₂, within the population that was not working at T₁. No significant results were found.

Table 3 Prospective factors for RTW in the whole study population, for different outcomes: odds ratios and 95% confidence intervals.

	Working with adjustments T ₁ vs. not working T ₁ ¹ n=361		Not working T ₁ and RTW T ₂ vs. not working T ₁ and T ₂ ¹ n=219		RTW with adjustments T ₁ and full RTW T ₂ vs. RTW with adjustments T ₁ and T ₂ ¹ n=136	
	Step 1	Step 2	Step 1	Step 2	Step 1	Step 2
Fatigue ²	.84 (.68-1.05)	.90 (.72-1.14)	.92 (.69-1.22)	.94 (.71-1.26)	.60 (.41-.86)	.55 (.37-.82)
Age ³	.78 (.59-1.02)	.76 (.57-1.00)	1.15 (.82-1.60)	1.12 (.80-1.57)	1.14 (.73-1.77)	1.20 (.76-1.87)
Men	2.45 (1.45-4.13)	2.48 (1.45-4.25)	.98 (.54-1.76)	1.00 (.55-1.82)	1.66 (.67-4.10)	1.97 (.76-5.13)
Job demands ²		.94 (.74-1.19)		1.16 (.87-1.54)		1.04 (.69-1.58)
Skill discretion ²		1.21 (.95-1.53)		1.00 (.77-1.31)		.57 (.36-.91)
Supervisor support ²		1.16 (.91-1.49)		1.23 (.91-1.65)		1.29 (.86-1.93)

¹ last mentioned category is reference group

² increase per standard deviation

³ 10-point increase

Full RTW at T₂ vs. RTW with adjustments at T₂, within the population that had returned to work with adjustments at T₁

Low fatigue was predictive of full RTW within four months after the onset of the sick leave, within the population that was working with adjustments two months after the onset of the sick leave (OR=.60, 95% CI .41-.86, p=.005). The height of the OR of fatigue was hardly affected by the inclusion of the work characteristics (OR=.55, 95% CI

.37-.82, $p=.003$). After controlling for fatigue, low skill discretion appeared to predict full RTW (OR=.57, 95% CI .36-.91, $p=.019$).

Table 4 Prospective factors for RTW with adjustments at T_1 in comparison with not working at T_1 (reference group), within diagnosis groups: odds ratios and 95% confidence intervals.

	Other health complaints n=95		Musculoskeletal n=136		Mental n=93	
	Step 1	Step 2	Step 1	Step 2	Step 1	Step 2
Fatigue ¹	.82 (.48-1.39)	.88 (.50-1.56)	.89 (.63-1.26)	.98 (.68-1.42)	1.13 (.68-1.90)	1.24 (.71-2.16)
Age ²	.63 (.35-1.11)	.62 (.34-1.10)	.93 (.59-1.47)	.97 (.60-1.55)	.71 (.38-1.30)	.69 (.36-1.32)
Men	3.83 (1.13-12.97)	3.70 (1.05-13.04)	3.61 (1.63-7.98)	4.07 (1.74-9.52)	1.56 (.47-5.20)	1.64 (.48-5.56)
Job demands ¹		1.16 (.71-1.90)		1.01 (.71-1.45)		.80 (.45-1.42)
Skill discretion ¹		1.13 (.70-1.83)		1.52 (1.00-2.31)		1.29 (.76-2.19)
Supervisor support ¹		1.26 (.75-2.11)		1.15 (.75-1.75)		.99 (.60-1.63)

¹ increase per standard deviation
² 10-point increase

Work resumption patterns within diagnosis groups

Work resumption patterns appeared to differ by diagnosis category (figure 2). Nearly half of the group of employees with musculoskeletal health complaints (48.1%) had already resumed work with adjustments at T_1 . This percentage was lower in the group with other physical health complaints (36.0%) and much lower in the group with mental health complaints (25.7%). Within the population not working at T_1 , there was hardly any difference between the diagnosis groups in the percentage of employees who returned to work with adjustments between T_1 and T_2 . There was however a difference between the diagnosis groups in the percentage of employees who were not working at T_1 but who had fully returned to work at T_2 . This happened most often in the group musculoskeletal and hardly happened within the group mental. Further, half of the employees within the group musculoskeletal who had returned to work with adjustments at T_1 had subsequently made the transition to full RTW at T_2 (52.0%). This percentage was about the same in the group other physical health complaints (47.2%) but much lower in the group mental health complaints (30.8%). Finally, in the group mental health complaints the highest number of employees failed to RTW in the first four months of the sick leave (40.6%), followed by the group other physical health complaints and the group musculoskeletal (30.0% and 21.8% respectively). In short, the work resumption process

in the first four months of the sick leave appeared to proceed slowest in the group mental and fastest in the group musculoskeletal.

RTW within diagnosis groups: RTW with adjustments vs. not working at T₁

Table 4 shows that in the group with mental health complaints, none of the included predictors had a significant effect on RTW with adjustments at T₁. In the groups of employees suffering from musculoskeletal complaints and other physical complaints, before and after controlling for work characteristics, men had a higher likelihood of having returned to work with adjustments at T₁ (second step: OR=4.07, 95% CI 1.74-9.52, p=.001; OR=3.70, 95% CI 1.05-13.04, p=.042 respectively). Moreover, in the group with musculoskeletal complaints, higher skill discretion had a marginally significant, positive effect on RTW with adjustments at T₁ (OR=1.52, 95% CI 1.00-2.31, p=.051).

Table 5 Prospective factors for RTW between T₁ and T₂ within diagnosis groups: not working at T₁ and RTW at T₂ in comparison with not working T₁ and T₂ (reference group). Odds ratios and 95% confidence interval

	Other health complaints n=58		Musculoskeletal n=67		Mental n=68	
	Step 1	Step 2	Step 1	Step 2	Step 1	Step 2
Fatigue ¹	1.97 (.97-4.00)	1.71 (.82-3.57)	.90 (.56-1.47)	1.13 (.66-1.94)	.73 (.40-1.35)	.68 (.35-1.30)
Age ²	.71 (.34-1.49)	.77 (.35-1.71)	1.06 (.57-1.98)	.95 (.47-1.91)	1.59 (.81-3.12)	1.58 (.79-3.17)
Men	.80 (.21-3.06)	.34 (.06-1.85)	.97 (.35-2.68)	1.54 (.50-4.76)	1.39 (.39-5.01)	1.27 (.34-4.66)
Job demands ¹		1.23 (.58-2.62)		1.18 (.71-1.93)		1.26 (.70-2.27)
Skill discretion ¹		1.35 (.72-2.52)		.96 (.55-1.66)		.89 (.52-1.52)
Supervisor support ¹		.41 (.16-1.08)		2.47 (1.25-4.86)		1.17 (.68-2.00)

¹ increase per standard deviation

² 10-point increase

RTW within diagnosis groups: full RTW or RTW with adjustments at T₂ vs. not working at T₂, within the population not working at T₁

In table 5 it can be seen that within the group with musculoskeletal complaints, higher supervisor support was strongly predictive of RTW between T₁ and T₂ (OR=2.47, 95% CI 1.25-4.86, p=.009). Within the group with other physical health complaints however, a marginally significant effect was found of low supervisor support on RTW between T₁ and T₂ (OR=.41, 95% CI .16-1.08, p=.072). In addition within this diagnosis group, and

also contrary to expectations, a marginally significant effect was found of higher fatigue on RTW between T₁ and T₂. Within the group with mental health complaints, no significant results were found. The results of this analysis in the groups with other physical illnesses and mental health complaints should be interpreted with caution due to low numbers.

RTW within diagnosis groups: full RTW at T₂ vs. RTW with adjustments at T₂, within the population that had returned to work with adjustments at T₁

We could only analyze the data in two steps within the group with musculoskeletal complaints because of insufficient subjects in the other diagnosis groups for this outcome. In table 6 it can be seen that within the group with musculoskeletal complaints, low fatigue was predictive of full RTW between T₁ and T₂ (second step: OR=.45, 95% CI .24-.83, p=.011). Inclusion of work characteristics did not affect the height of the OR. Higher supervisor support had a strong positive effect on full RTW between T₁ and T₂ (OR=2.60, 95% CI 1.15-5.89, p=.022).

Table 6 Prospective factors for full RTW between T₁ and T₂ within diagnosis groups: working with adjustments at T₁ and full RTW at T₂ in comparison with working with adjustments T₁ and T₂ (reference group). Odds ratios and 95% confidence intervals.

	Musculoskeletal n=68		Mental ³ n=25	Other health complaints n=28
	Step 1	Step 2	Step 1	Step 1
Fatigue ¹	.48 (.29-.81)	.45 (.24-.83)	1.03 (.47-2.26)	.29 (.07-1.17)
Age ²	.74 (.38-1.46)	.70 (.35-1.40)	1.35 (.44-4.11)	4.37 (1.22-15.59)
Men	1.27 (.33-4.85)	2.63 (.55-12.59)		1.06 (.05-23.36)
Job demands ¹		1.27 (.68-2.38)		
Skill discretion ¹		.53 (.24-1.17)		
Supervisor support ¹		2.60 (1.15-5.89)		

¹ increase per standard deviation
² 10-point increase
³ men and women analyzed together due to low numbers; splitting the analyses did not reveal any difference in the results

Also in table 6 are some results of the analyses within the groups with mental health complaints and other physical complaints. The results of the first step of the analyses are depicted. Considering the height of the OR, there is probably no effect of fatigue within the group mental for this outcome (OR=1.03, 95% CI .47-2.26). This conclusion is more

doubtful within the group other physical health complaints since within this group a marginally significant effect of fatigue was found (OR=.29, 95% CI .07-1.17, $p=.081$). The effect after correcting for work characteristics in the analyses within these diagnosis groups is however unknown. Further, within the group with other physical health complaints, a higher age was predictive of full RTW between T_1 and T_2 (OR=4.37, 95% CI 1.22-15.59, $p=.023$). It should be noted that the results of this analysis within the groups with other physical illnesses and mental health complaints should be interpreted with caution due to low numbers.

Discussion

The aim of the present study was to investigate the predictive value of fatigue for early RTW. We only found a significant effect of fatigue for one outcome in the whole study population. Within the subpopulation that was working with adjustments at T_1 , higher fatigue appeared to obstruct full RTW between T_1 and T_2 . Fatigue had a significant effect before and after correcting for demographics and work characteristics. When this outcome was studied within diagnosis groups, a significant effect of fatigue was only found within the group with musculoskeletal health complaints (before and after correcting for demographics and work characteristics). In addition, fatigue was found marginally significant in the group with other physical health complaints after correction for demographics. It should be noted that results appeared unstable in this diagnosis group probably due to low numbers and/or too much heterogeneity in this diagnosis group. Low numbers entailed that we could not investigate the influence of work characteristics as potential confounders in this particular analysis. Additional research is needed within bigger populations of specific diagnoses that fell within this diagnosis category in the present study (i.e. respiratory diseases, diseases of the circulatory system, diseases of the neurological system and diseases of the digestive system). Bigger populations may increase the analytical power in the analyses. A split up of the diagnosis group with other physical health complaints into more specific diagnoses may further increase the insight in the effect of fatigue on RTW since it is not known as yet whether the role and the experience of fatigue can be generalized across chronic diseases (Franssen et al., 2003; Glaus et al., 1996). Considering the above, it was concluded that the effect of fatigue that was found in the whole study population was strongly guided by the effect of fatigue that was found within the group musculoskeletal.

The effect of fatigue in the group with musculoskeletal complaints on full RTW, within the population that had returned to work with adjustments at T_1 , may be related to general health (co morbidity), severity of complaints or to bad coping with musculoskeletal complaints. Further, related to the fact that fatigue was stated before the onset of the sick leave, the role of fatigue in the onset or course of musculoskeletal complaints is not clear as yet. The background of the effect of fatigue on full RTW is important to find out, since this knowledge has consequences for the timing and the contents of interventions aimed at the prevention of prolonged partial RTW. Additional analyses revealed that

inclusion of the potential confounders long-term illness and general subjective health in the analyses did not affect the OR of fatigue. This excludes one possible explanation for the effect of low fatigue on full RTW within employees sick-listed due to musculoskeletal complaints.

In the whole study population, men had a higher likelihood of having returned to work with adjustments two months after the onset of the sick leave (at T_1). This effect was guided by the effects of gender on RTW with adjustments at T_1 that were found within the diagnosis groups with musculoskeletal and other physical health complaints. Moreover, younger employees had a higher likelihood of having returned with adjustments at T_1 . This effect was not replicated within the diagnosis groups that were distinguished in the present study. Lower skill discretion induced full RTW within the group that was working with adjustments at T_1 . This was against our expectations (Janssen et al., 2003a), it was not replicated within the diagnosis groups, and it was only found when we controlled for fatigue. Moreover, a univariate analysis revealed no significant differences in scores on skill discretion between the groups that constituted the outcome. For these reasons this effect was considered dubious, unstable, and probably caused by specific, accidental interrelationships between the research variables in the study population.

In the whole study population no significant effect was found of supervisor support on RTW. Within diagnosis groups, *lower* supervisor support was marginally predictive of RTW between T_1 and T_2 within the group with other physical health complaints, while *higher* supervisor support was strongly predictive for RTW between T_1 and T_2 within the group with musculoskeletal complaints. The different direction of the effect of supervisor support between the group with musculoskeletal complaints and the group with other physical health complaints cannot be explained on the basis of the present analyses. Future studies may reveal more on the stability of these findings. This is particularly true for the finding within the group with other physical health complaints, considering the low numbers in the analysis. More research is also needed on the background of the relationship between supervisor support and RTW within diagnosis groups (i.e. the nature of the support, relation with sociomedical guidance). In the present study, the supervisor support that affected RTW was measured before the onset of the sick leave. The contrasting results across diagnosis groups do explain the lack of significant effect finding of supervisor support in the whole study population.

Contrary to the findings in the present study, in a former study in which the same study population was used as in the present study, a positive effect of supervisor support on RTW was stated in the whole study population (Janssen et al., 2003). The contradictory results can be explained by the fact that in this former study, fatigue was not included in the analyses, analyses were not stratified by diagnosis groups and no distinction was made between work resumption patterns. Instead, the work status at four months after the onset of the sick leave (at T_2) was taken as an outcome.

The present study revealed that the rather strong effect of supervisor support within the group musculoskeletal was only significant in the prediction of RTW after T₁, that is in the third and fourth month of the sick leave episode. This finding may point at different stages in the disability process with corresponding, distinctive determinants of RTW.

In general, it can be concluded from the present study that (early) RTW with adjustments is an important intermediate phase between not working and full RTW. Many employees made use of this option. Relapses were scarce within the group of employees who returned to work with adjustments. Further, the present study made clear that the pace of the work resumption differed across diagnosis groups. In the group with musculoskeletal complaints the highest pace of RTW was found, in the group with mental health complaints the lowest. The slow pace of RTW and the high risk of being awarded a disability benefit within the latter group, is in line with earlier studies (Veerman et al., 2001). Schröer (1993) for example found that more than 20% of a population diagnosed as being 'overstrained' did not return to work within one year (Schröer, 1993).

Within the group with mental health complaints, no effect of fatigue was found on RTW. This is a remarkable finding, as fatigue is an important symptom of mental health complaints (Hoogduin et al., 1999; Van Dijk & Swaen, 2003). Although the level of fatigue was significantly higher in this diagnosis group than in the other diagnosis groups, it seems not likely that the lack of significant effect finding was due to too little variety in fatigue scores within the group with mental health complaints.

Future studies should reveal more on diagnosis-specific determinants of RTW other than fatigue (e.g. sociomedical guidance, health behavior; Krause et al., 2001). In the present study, strong differences in work resumption patterns led to relatively low numbers of subjects in some analyses within the diagnosis groups with mental and other physical health complaints. This entails that the results of the findings within these diagnosis groups should be interpreted with caution. Future studies is needed to corroborate the present findings. A longer follow-up may be necessary for the study of determinants of (early) RTW within the diagnosis groups in which the RTW process is later initiated.

On the basis of the results of the present study it can be concluded that fatigue did not obstruct employees to RTW. However, the higher the fatigue score of employees with musculoskeletal health complaints, the longer they remained working with adjustments. Since in the Netherlands the employer is responsible for the sickness benefits, and since RTW with adjustments means that one is not functioning at full production level, this is an important finding for employers. Monitoring fatigue, and intervening early in fatigued employees, may not only prevent the onset of sickness absence in general (Janssen et al., 2003b), but may also prevent prolonged partial RTW in employees with musculoskeletal health complaints. The theoretical contribution of the present study lies in the conclusion that (some) determinants of the onset of the sick leave, such as fatigue, may have less predictive value in predicting the termination of the sick leave, as measured by RTW.

Acknowledgements

The Maastricht cohort study is part of the Netherlands concerted action on 'Fatigue at work', which was granted by the Netherlands Organization for Scientific Research (NWO). The present study was supported by NWO grant no. 580-02.252.

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7

Epilogue

Introduction

Little is known on the course of fatigue at work and the risk factors that apply to different outcomes that are found in this course. These outcomes include the prolongation of fatigue, the onset of sickness absence and early return to work in long-term sick-listed employees. Risk factors in the prolongation of fatigue may be different from those found in the etiology of fatigue. Regarding this, the present thesis dealt with three research questions that were investigated in a working population: 1) 'What is the role of work characteristics in the natural course of fatigue?' 2) 'What is the effect of fatigue on the onset of sickness absence?' and 3) 'What are the effects of work characteristics and fatigue on early return to work (RTW)?'. The aim of this epilogue is to transcend the level of the results and discussion points that were reported in the chapters 2-6. Instead, more general methodological issues of the way we studied the research questions are reflected upon. First, the most important conclusions of the consecutive studies are given. The studies are presented by research question, as formulated in the introduction section of this thesis. Next, some general methodological considerations of the present thesis are described. Subsequently, the theoretical implications of the results are presented as well as some recommendations for future research on the course of fatigue in a working population. Finally, in the last paragraph, the practical implications of the study are described.

Main findings

The role of work characteristics in the natural course of fatigue

In the chapters 2 and 3 of this thesis, it was explored whether the effect of work characteristics that was established in the etiology of fatigue (Bültmann et al., 2002a) can be extended to the course of fatigue. In a first study on the role of work characteristics in the natural course of fatigue, a well-known work stress model, the Demand-Control-Support (DCS) model was taken as the starting point. It was hypothesized that a decrease in psychological job demands, and an increase in decision latitude (job control) and social support at work would go together with a reduction in fatigue, psychological distress and emotional exhaustion, as compared with (nearly) no change in these work characteristics. This hypothesis was investigated over a one-year follow-up period. The hypothesized relationships were confirmed by the results. This first study revealed a complex, potential bi-directional interrelationship between levels of work characteristics and changes in these work characteristics on the one hand and changes in fatigue in the general working population on the other hand (Williams & Podsakoff, 1989). The comparable effects of the levels and changes in the work characteristics on the three health outcomes can be considered as evidence for the convergent validity of the Checklist Individual Strength (CIS), which was used to measure fatigue.

In contrast with the first study on the relationship between work characteristics and the course of fatigue, in a second study the focus was on a fatigued working population.

Within this population, work-related determinants of a change in the fatigue state over a one year follow-up period were investigated. A second distinguishing characteristic of this study was that the predictors (levels and changes in work characteristics) were both measured before the outcomes so that causal inferences could be made more plausible compared to the design that was used in the first study on the course of fatigue (Zapf et al., 1996). Third, the four fatigue dimensions (i.e., subjective fatigue, reduction in motivation, reduction in concentration and reduction in activity) were separately explored. Fourth, a wider variety in work characteristics was included in comparison with the first study. Positive changes in the work characteristics as well as positive levels of these work characteristics were hypothesized to predict a decrease in fatigue. It was found that a decrease in psychological job demands predicted a decrease in scores on all fatigue dimensions. In addition, an increase in decision authority led to a positive change in the motivational dimension of fatigue.

In the two studies on the course of fatigue in the strict sense, the additionally explained variance by the levels of the work characteristics and the changes in the work characteristics was not high when taking into account the high stability coefficient of fatigue. It was not likely that the low additionally explained variance could be attributed to a high baseline interrelationship between work characteristics on the one hand and fatigue (or demographic characteristics) on the other hand, since these were only moderately associated. In this regard it should also be noted that in the second study on the course of fatigue, the differences in stability coefficients across the four fatigue dimensions were primarily responsible for the fact that different figures of total explained variance were found. Work characteristics had a comparable low contribution to all fatigue dimensions. Thus, the course of fatigue is only for a small part influenced by work characteristics.

The effect of fatigue on sickness absence

One of the consequences of fatigue at work may be an increased risk of sickness absence. Therefore, we investigated in a third study on the course of fatigue, the role of fatigue as a predictor for the onset of sickness absence in the short term. Sickness absence was objectively assessed on the basis of organizational absence records and measured over the six months immediately following the baseline questionnaire. Although the reliability of self-report sickness absence data appears to depend on the recall period, to be on the safe side is to assess objective sickness absence data from company records (Severens et al., 2000; Van Poppel et al., 2002). A preliminary survival analysis revealed a strong crude relationship between fatigue and subsequent sickness absence. Further analyses focused on the relationships between fatigue and long-term sickness absence (>42 days) and between fatigue and the time-to-onset of the first short sickness absence spell (1-7 days). It was concluded that fatigue is related to future short-term and particularly to future long-term sickness absence. The effects were still present after controlling for potential sociodemographic and work-related confounders.

The effects of fatigue and work characteristics on early RTW

The last two studies regarding the course of fatigue in this thesis focused on early RTW. Early RTW was operationalised as RTW within the first four months in long-term (6-8 weeks) sick-listed employees. In contrast with many previous studies in which work characteristics were related to RTW, the work characteristics were measured before the onset of the sick leave, in order to get an unbiased view of the working situation.

The first study used the Demand-Control-Support (DCS) model as a starting point to investigate whether the established effects of work characteristics in the onset of illness (Cooper & Payne, 1988; De Jonge & Kompier, 1997) could be extended to early RTW as one of the outcomes in the course of that same illness. Similarly, work characteristics were found to play a role in the onset of sickness absence (e.g. Niedhammer et al., 1998; Smulders & Nijhuis, 1999) and work characteristics might therefore also affect the termination of this sickness absence. In line with the DCS model, main effects as well as interactive effects of continuous work characteristics were included as predictors. A distinction was made between RTW with adjustments and full RTW. The strongest statistical evidence was found for an effect of high supervisor support on full RTW compared to not working four months after the onset of the sick leave. Further, some marginally significant results were found. In a second study on RTW, fatigue was investigated as a predictor in the whole study population as well as within three diagnosis groups (i.e., mental, musculoskeletal and other physical health complaints). Also, work resumption patterns were studied within the total group and within the diagnosis groups. In general, the majority of all long-term sick-listed employees returned to work with (temporary) adjustments as a first step towards full RTW. This work resumption pattern was much more common than the pattern in which employees immediately fully returned to work within the first four months of the sick leave (see also De Rijk et al., 2002; Van der Klink et al., submitted). Further, the work resumption patterns appeared to differ across diagnosis categories. The RTW process started earliest within the group musculoskeletal and latest within the group mental. Descriptive analyses also revealed that whereas there were no or very small differences in work characteristics and general health between the groups, there were clear differences in fatigue. Explanatory analyses revealed that fatigue induced full RTW in the group that was working with adjustments just after inclusion in the study. Stratification of the analyses by diagnosis groups revealed that this effect of fatigue differed by diagnosis group. Within the group mental, no effect of fatigue was found while the effect of fatigue in the whole study population could probably be attributed to the strong relationship that was found within the group musculoskeletal. In addition, we found indications that, next to fatigue, the predictive value of sociodemographic and work-related characteristics might also differ by diagnosis category. Since little is known as yet on early RTW, future study is needed to corroborate our findings. Further, in some analyses within the diagnosis groups with other physical illnesses and mental health complaints, the low numbers in the outcome categories might have contributed to analytical power restriction which in turn might have contributed to the lack of significant findings. The results indicate that, considering the slow initiation of the RTW process, higher numbers of employees who are sick-listed due to stress-related disorders and other physical health

complaints should be included in future studies on early RTW. Or, the definition of early RTW should cover a longer absence duration for these diagnosis groups as compared with the definition for the group with musculoskeletal complaints.

General methodological considerations

This study was part of a large-scale cohort study conducted in the Netherlands. As indicated in the introduction, a prospective study design is necessary to investigate the risk factors in the course of fatigue in a methodologically neat way. Conclusions on cause and effect can be made more plausible and potentially effects of self-report bias on the results might be reduced by appropriate analysis. However, longitudinal research cannot solve the problem of potential selective baseline response and brings attrition or selective follow-up non-response as a potential problem that is specific to longitudinal research. Selective baseline or follow-up response might bias the study results. This might particularly lead to problems for descriptive research questions but might also affect the results of explanatory analyses. By investigating the baseline non-response, we could draw tentative conclusions on the selectivity of the cohort composition. The methods and results of this study are set forth in detail in the appendix of this thesis. Limited data that were most important in regard of the aims of the Maastricht cohort study were collected on a random sample of the baseline non-respondents. Their characteristics were compared with the characteristics of baseline cohort participants. The results indicated that baseline non-respondents reported less often to have experienced fatigue complaints in the last months at the time of the baseline measurement. No differences were found regarding subjective general health. It was concluded that the non-response might have affected the descriptive aims of the Maastricht cohort study as indicated by a slight overestimation of the prevalence of fatigue. Since variety in fatigue and other characteristics in cohort participants was however still guaranteed, it was concluded that explanatory analyses can hardly be *affected to a great extent. Conclusions should however be interpreted with caution.* After all, the conclusions of the non-response analyses were based on a group of non-respondents who were not willing to fill out the extensive baseline questionnaire but who were willing to fill out the short non-response questionnaire. The selectivity of this group of non-respondents is not known.

The consequences regarding the overall non-response and overall attrition for the studies might be altered for the present thesis due to different selections of participants in the studies that were reported on in this thesis. Further, potential selective follow-up non-response might have altered the conclusions on the selectivity of the baseline response for the results of the Maastricht cohort study in general. A non-response analysis after one year follow-up indicated that follow-up non-respondents reported higher fatigue levels at baseline than respondents (Kant et al., 2003; Van Amelsvoort et al., 2004). Regarding health characteristics, it thus appeared that employees with more health complaints were more eager to respond to the baseline questionnaire but that they were also more likely to having discontinued their participation after one year of follow-up. Although strict inclusion and exclusion criteria were applied in the study of the

course of fatigue, the conclusions on the characteristics of the dropouts are in line with the conclusions of the follow-up non-response as reported on in individual studies of this thesis. A worse health status of follow-up non-respondents as compared with continuous respondents is a common finding in longitudinal research (Taris, 2000). Within the sample of long term sick-listed employees (chapter 5 and chapter 6), initial non-response was nonselective with regard to the study variables, except for gender and age. Variation in the study variables was still high. Follow-up non-response was nonselective regarding the study variables.

Overall, any existing differences between initial non-respondents and respondents or differences between follow-up non-respondents and continuous respondents are not likely to have affected our explanatory research questions, since variety in the study variables was ensured.

The large-scale study in which we conducted our research made that we were able to exclude some disturbing external influences in the first three studies that were reported on. This particularly applies to the fact that we excluded employees reporting to suffer from a long-term disease in the studies that were reported on in the chapters 2-4. As indicated in the introduction, fatigue may have differential meanings, roles and correlates across long-term diseases. Nevertheless, due to the lower number of participants in the analyses on RTW within long-term sick-listed employees, we were only able to control for the presence of a long-term diseases. In the analysis on the relationship between fatigue and RTW it was however concluded that the conclusions were still the same after controlling for the presence of a long-term disease.

Theoretical implications

The results of the present thesis suggest that research models applying to the etiology of fatigue on the one hand and the course of fatigue in its broadest sense on the other hand might differ in regard to the stress that is laid on some (sorts of) predictors. Similarly, predictors might differ for the subsequent stages in the course of fatigue. These stages include the onset of sickness absence and the termination of sickness absence, which were investigated in the present thesis. Furthermore, indications were found that predictors of RTW might differ by diagnosis groups. The overall conclusions can be explained as follows. First, as mentioned above, in chapter 3 it was found that only a selection of all relationships between work characteristics and a change in the fatigue state that were tested in a fatigued working population were found significant. In addition, explained variance by the work characteristics was low. A wider variety, and (partly) other work-related factors were found predictive for the etiology of fatigue (Bültmann et al., 2002a). Notwithstanding this, firm conclusions are not possible due to methodological differences in the analyses on the etiology as compared with the analyses in the present study. Different methods refer to different analysis techniques, different operationalisations, different predictors and potential confounders, and different inclusion and exclusion criteria. However, as mentioned before, work characteristics are generally known to play an important role in the etiology of adverse health at work and in the etiology of sickness absence (Cooper & Payne, 1988; De Jonge & Kompier, 1997;

Smulders & Nijhuis, 1999). Further, the dominating predictive role of fatigue itself in the course of fatigue makes the course of fatigue a complex research issue.

Thus, although there were indications that research models that apply to the etiology and course of fatigue (in its strictest sense) might differ, more research is needed on this subject. Strong conclusions can be drawn on the limited role of work characteristics in the course of fatigue with regard to later stages in the illness process. The study on RTW (chapter 4) revealed that work characteristics played only a marginal role in the prediction of early RTW in the total population. Although the results of the last chapter indicate that attenuation of regression coefficients might have occurred in chapter 5 due to indications that were found in chapter 6 for diagnosis-specific determinants of RTW, it is not very likely that our overall conclusion on the effect of work characteristics on RTW is altered if analyses are stratified by diagnosis categories. Thus, work characteristics appear to play a limited role later in the course of the illness process. Similar results on a limited effect of work characteristics on RTW were obtained in some other (Dutch) prospective studies conducted in long-term sick-listed employees (De Rijk et al., 2002; Schröer, 1993; Van der Klink et al., submitted). However, these studies did not specifically aim at early RTW. In studies in other countries, which included stage-specific stratified analyses work characteristics were found significant in the prediction of RTW (Dasinger et al., 2000; Krause et al., 1997; Krause et al., 1998).

Indications on the validity of different determinants of the onset of a sickness absence and the termination of it was found while comparing the results of chapters 4 and 6. Fatigue had a strong impact on particularly long-term sickness absence in the whole study population. The effect of fatigue on RTW seemed however limited to the group musculoskeletal¹ and was confined to a particular subgroup namely those employees who firstly had returned to work with adjustments in the first two months of the sick leave. More research is needed on the potential differential predictors of RTW across diagnosis categories, and of the role of fatigue in the prediction of sickness absence within diagnosis categories in order to enable more readily comparison of the predictors of sickness absence and RTW. Still we think that indications were present in this thesis that determinants of the sickness absence threshold appear different from the determinants of the RTW threshold (Philipsen, 1969; Smulders & Veerman, 1990). We also think that indications were present that predictors of RTW might differ by diagnosis category. For theory on the illness process this would mean that stage-specific and diagnosis-specific theoretical models should be invented.

Recommendations for future research

It can be stated that considering that a prevalence of 22% was observed in 1998 (Bültmann et al., 2002b), a high stability of fatigue, and a strong relationship of fatigue

¹ It should be noted that for this particular outcome, the results within the groups that were sick-listed due to mental and other physical health complaints should be interpreted with caution due to low numbers.

with particularly long-term sickness absence, it can be stated that there is an urgent economic and social need to get more insight in the course of fatigue.

In the study of the risk factors in the natural course of fatigue in the strict sense, changes in work characteristics as well as levels of work characteristics were studied. Changes in work characteristics as predictors provide more unequivocal evidence for effects of interventions than effects of (only) levels of work characteristics. This is because causal effects can be made more plausible, because more other explanations, namely some of those relating to the influence of third variables on the results, can be ruled out if changes in predictors are studied in comparison with only levels of predictors (Rodgers, 1989). Ruling out other plausible explanations than a pure causal effect is one of the necessary conditions to speak of a causal effect (Cook & Campbell, 1979). Few studies thus far focused on changes in predictors (De Lange et al., 2002). It is therefore recommended in future research to study changes in work characteristics more often.

As stated earlier, the variance in the course of fatigue that was explained by the work characteristics was low. It therefore seems that the practical, clinical relevance of an intervention in (only) work characteristics might be limited. However, it should also be stated that it may be idealistic to expect high explained variance, because well-being and health are multifactorially determined (Semmer et al., 1996). This entails that a combination of several sorts of predictors might have the most pronounced effect on an outcome. Since the course of fatigue is a relatively unexplored research issue, future studies may provide indications on other intervention possibilities that might be combined with an intervention in work characteristics.

Frese and Zapf (1988) recommended detailed research on the different models applying to the time course of cause and effect (i.e. differential exposure time models or initial impact model) that might apply to a specific relationship between a work characteristic and an outcome (Frese & Zapf, 1988). However, since the present thesis showed that work characteristics only play a limited role in the course of fatigue and since other non-work related factors are not yet explored, the study of these other factors might best be given priority over and above a detailed study on the specific time course of the effects of work characteristics in the course of fatigue. These 'other' factors may be found in the literature on the course of fatigue in clinical populations. For example, psychological factors were found predictive of persistent fatigue such as cognitions concerning subjective sense of control over symptoms and physical attribution of fatigue complaints (De Vries et al., 2001; Vercoulen et al., 1996). The duration of fatigue complaints (i.e. cumulative exposure; Frese & Zapf, 1988) was also found predictive of persistent fatigue in many studies on the course of fatigue (Bombardier & Buchwald, 1995; Clark et al., 1995; Ridsdale et al., 1993; Vercoulen et al., 1996) and may therefore be further explored in the study of the course of fatigue in the working population. Specific models as mentioned by Frese and Zapf (1988) may also be applicable to the relationship between fatigue and its consequences in terms of sickness absence and RTW. For

example, the exposure time to fatigue might affect the nature and strength of predictors for these outcomes.

More study is needed on the interrelationships, the course and the differential predictors of the four separate fatigue dimensions. This was concluded on the basis of the findings in chapter 3. First, it was found that predictors were differentially related to the four fatigue dimensions. Second, although the factor loadings remained the same across the three measurements, the interrelationships changed, particularly the relationships between psychological job demands and subjective fatigue on the one hand and the activity dimension of fatigue on the other hand. The first mentioned relationship was unexpectedly negative within a population of only fatigued employees as well as within a population of mixed fatigued and nonfatigued employees. The second mentioned relationship was of equal strength but of reversed sign within an only fatigued employee population as compared with a population including fatigued and nonfatigued employees.

We found a strong relationship between fatigue and sickness absence. One of the possible mechanisms that explain the cross-sectional relationship between fatigue and stress-related disorders, as described in the introduction of this thesis, is that fatigue may have a future effect on the onset of stress-related disorders. In future research, it might therefore be interesting to split the analyses by diagnosis categories. It might further be interesting to investigate the relationship between fatigue and sickness absence also within other diagnosis categories, as fatigue may play a role in the course of diagnosis categories other than mental (see chapter 6). A remarkable finding regarding the results of the analyses on RTW was that one of the most common complaints in the diagnosis group mental, fatigue, did not affect early RTW. Thus, it is likely that within this diagnosis group other factors play a role. The factors affecting early RTW in this diagnosis group need attention in future research. Further, it should be investigated why it was found that the RTW process was only initiated after a relatively long absence duration in this group.

Early RTW is not often studied. Rather, late RTW or disability pension are studied as outcomes which is probably related to the fact that these measures are more readily available. The grant of a disability benefit is however likely to be (partly) determined by other determinants than RTW. As in many other countries, in the Netherlands, the allowance of a disability benefit is based upon a medical and vocational assessment as executed by a physician. Early RTW though, is based on consensus between the employer, the occupational physician and the employee (Van der Giezen et al., 2000). Further, little is known as yet on the potential of the generalization of results on predictors of RTW in general to early RTW. This is related to the fact that the nature and strength of predictors were found to differ by varying lengths of time out of work (Gallagher et al., 1989; Lancourt & Kettelhut, 1992). Thus, more research is needed on early RTW (see also Shrey & Lacerte, 1997). Fortunately for theory and for the promotion of early intervention, some recent studies on RTW focus on early RTW (Van der Klink et al., submitted) or distinguish in the study of the determinants of RTW between acute and more chronic stages (i.e. as defined on the basis of absence

duration) in the course of the sick leave (Dasinger et al., 2000; Krause et al., 2001; Van der Giezen et al., 1996). As stage-specific models appeared promising in the study of RTW in low back pain patients (Dasinger et al., 2000; Frank et al., 1998; Krause & Ragland, 1994; Krause et al., 1998), this approach might also be promising in other populations. The definition of the period of the more acute and chronic stages are likely to differ by the nature and severity of the illness.

Although the results of the present study suggest that the investigated work-related and sociodemographic risk factors, and fatigue appeared to be diagnosis-specific predictors for early RTW, this might not hold for other sorts of predictors. Therefore, studies should best enable comparison of the effects of risk factors between diagnosis groups. In this way, it might become clearer for physicians and employers what factors should be treated diagnosis-independent and what factors should be treated diagnosis-dependent in interventions aimed at early RTW. Fatigue as a predictor of RTW should be further explored (cf. Shaw & Polatajko, 2002) within the groups that were sick-listed due to mental and 'physical illnesses other than musculoskeletal', because strong conclusions were not possible concerning some categories of RTW due to low numbers.

It was determined earlier that different research models may apply to different stages of the illness process. This entails that different interventions are also appropriate within the different stages in the course of fatigue. Consequently, future studies should account for the specific stage in the course of fatigue that employees find themselves in.

In the course of health complaints, recurrences form an interesting subject (Baldwin et al., 1996). One of the risk factors for recurrences might be that employees who have a history of fatigue, might be more prone to be fatigued again during follow-up. This would be an interesting subject for future study. Further, the course of fatigue after (long-term) sickness absence might be an important study subject. It might be that (particularly long-term) sickness absence is an important coping strategy at work to enable recovery (cf. Kristensen, 1991). Does a positive change in the fatigue state take place after sickness absence, and is this change bigger than in employees who do not decide to report ill? In this way a reciprocal relationship between fatigue and sickness absence might be revealed. Finally, recurrences of (long-term) sickness absence might be further explored within the group in which early RTW was investigated.

Practical implications

The results in the present study reveal some indications for interventions aimed at the prevention of chronic health complaints, long-term sickness absence and lack of RTW. In the Netherlands, employers are legally responsible for the execution of a so-called risk assessment and sociomedical guidance of absent employees (Schaufeli & Kompier, 2001; Weel et al., 1999). In the execution of these tasks, they are assisted by the occupational physician. In addition, employers are financially responsible for sickness benefits. Consequently, they can directly benefit from indications for practical intervention (Shrey & Lacerte, 1997).

We found that in a mixed population of fatigued and nonfatigued employees, changing the demands, control and/or support in a positive way will lead to a positive change in fatigue. In a fatigued employee population however, the focus should be on a limited selection of work characteristics. While a reduction of psychological job demands will induce a reduction of fatigue in all of its dimensions, an increase in decision authority will only lead to a positive development in the motivational dimension of fatigue. In the latter case, subjective fatigue remains unchanged. Consequently, the practical relevance of an intervention in decision authority might therefore be questioned. Further, it is likely that interdisciplinary interventions in work characteristics as well as in other sorts of predictors might be more fruitful to induce a marked change in the fatigue state in fatigued employees as compared for example with interventions solely aimed at work characteristics.

Specific aim of the present study was to increase the insight in the course of fatigue in a working population. By increasing the insight in the temporal stability of the condition and in its possible consequences among employees, the present study gave indications for the severity of fatigue in a working population. The severity of fatigue was illustrated by the findings that fatigue had a strong effect on the occurrence of particularly long-term sickness absence, which may stress the experience of fatigue as a disabling health complaint. Further, fatigue was a robust phenomenon, considering that two thirds of the fatigued population that was selected in chapter 3 was still fatigued one year later. The rate of persistence found in the present study is towards a poor prognosis as compared to rates of persistence found in previous research in community and primary care settings (e.g. Addington et al., 2001; Hickie et al., 1999; Joyce et al., 1997; Skapinakis et al., 2003; Van der Linden et al., 1999). It should be noted though that differences in definitions of fatigue, operationalisations of fatigue, settings and follow-up periods hinder direct comparison of rates of persistence (Skapinakis et al., 2003). A rate of persistence as high as two thirds entails for practice that it might be useful to include a fatigue measure in the legally obliged risk inventory in the Netherlands, in order to detect risk groups with a high fatigue score to prevent negative work-related consequences such as more chronic forms of fatigue, long-term sickness absence and work disability. The stability of fatigue over a relatively long time means that time is available to intervene.

In chapter 6 it was found that the level of fatigue was much higher within the diagnosis group mental in comparison with the other diagnosis groups. This is in line with the fact that fatigue is a core symptom of stress related disorders (Csányi, 1999; Hoogduin et al., 1999; Van Dijk & Swaen, 2003). Although the results of some analyses on RTW within this diagnosis group should be interpreted with caution, indications were found that fatigue had no effect on early RTW. If corroborated in future research, this does not mean that fatigue should not be treated in this diagnosis group. It does suggest that next to the treatment of health complaints, other than interventions aimed at a reduction in fatigue should be applied to induce early RTW in this diagnosis group.

Finally, the fact that it was concluded that different research models apply to different stages of the course of fatigue indicates that specific interventions should be dependent on the stage in the course of fatigue that employees find themselves in.

Overall conclusion

In general, the course of fatigue is a relatively unexplored study subject despite the fact that it may provide clear indications on secondary prevention possibilities. The present study however also revealed that it is a complex research subject as the study on the course of fatigue includes differential stage-specific risk factors.

It should be noted that the underlying processes of the course of fatigue in its broadest sense are independent of any changes in the legislation and regulations in occupational medicine. Thus, the conclusions on specific relationships and on practical implications of the present study are not affected by recent and future changes in occupational medicine.

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Appendix

A non-response analysis in a health survey: the Maastricht cohort study on fatigue at work

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Abstract

The aim of this paper was to describe the methods and results of a non-response analysis that was conducted within the Maastricht cohort study on fatigue at work. A non-response analysis gives insight in the presence of a selection bias. The results showed a selection bias with regard to some, mainly health characteristics. The conclusions are interpreted in light of the objectives of the Maastricht cohort study.

Introduction

Inherent in every survey study based on voluntary participation is a certain non-response percentage. Taris (2000) noted that non-response rates of 30 to 40% are not unusual nowadays. It can be assumed that a big part of the non-response is based on a rational decision (Childers and Skinner, 1996). This entails that insight in the determinants of response behaviour is useful; insight enables the design and application of interventions aimed at maximization of the response rate and minimization of survey costs. Childers and Skinner (1996) developed a theoretical framework on mail survey response behaviour. They approached the issue building on the ideas of the exchange/equity theory and argued that before commitment to participation in the study is achieved, the conditions of equity and trust should be met. The presence of equity is evaluated by weighing the perceived personal or societal benefits to the perceived costs of participation. Childers and Skinner (1996) note that the main benefit from cooperation is probably the opportunity to have input into or to shape the surrounding environment. The condition of trust is met if the potential participant has a feeling of trust in the outcomes of the study (Childers & Skinner, 1996). Cavusgil et al. (1998), who also developed a theory on response behaviour, came to a similar model. However, they went into more detail and included the concepts of net individual benefit, societal outcome, commitment, novelty, convenience and expertise as factors that influence response behaviour (Cavusgil & Elvey-Kirk, 1998). For each of the concepts that were included in the above-mentioned theories, a response inducing intervention can be invented. Still, both Cavusgil et al. (1998) and Childers and Skinner (1996) acknowledge that there is also an uncontrollable part of non-response behaviour (i.e. situational factors) which refers for example to 'the bad moment' at which the appeal is done, or a bad attitude towards survey studies in general.

The maximization of response rates on the basis of insight in response behaviour is not only important for efficiency reasons, but may also decrease the risk of selection bias (Green, 1996). A selection bias is present if a selective (non-random) group does not cooperate. In that case, the study population is not a good representation of the target population. This hinders the generalization of the study results (Taris, 2000). Therefore it is important to investigate the presence of selection bias by conducting a non-response analysis in which differences between respondents and non-respondents are stated (Martin, 1994). Subsequently, the results of the non-response analysis are interpreted in light of the study objectives. In 1998, the large-scale Maastricht cohort study on fatigue at work was initiated. The aim of the present paper was to describe the non-response analysis that was executed within this research framework. Therefore, first a general introduction on the Maastricht cohort study is given to clarify the research framework. Next, the methods and results of the non-response analysis are described.

The Maastricht cohort study on fatigue at work

The Maastricht cohort study is part of a national concerted research program on 'Fatigue at work'. The Maastricht cohort study was set up since little is known on the prevalence, risk factors and consequences of fatigue in the working population. Insight was considered particularly important, since fatigue is an important symptom among employees sick-listed and work disabled due to stress-related disorders. About one in every three work disability benefit recipients is classified as disabled on mental grounds (Veerman et al., 2000). In view of this, the objectives of the cohort study were 1) to determine the prevalence and incidence of fatigue at work 2) to identify risk factors in the etiology and course of fatigue and 3) to investigate the effectiveness of treatments for fatigue. The overall aim was to give indications on preventive measures that can be used at work (Kant et al., 2003).

In order to be able to study the etiology and natural course of fatigue at work, a large heterogeneous employee cohort was recruited in May 1998. Employees received a mailed, extensive questionnaire and an introductory letter in which they were invited for participation, at their home addresses. The baseline questionnaire included work-related, non-work related and health-related variables. In the introductory letter some general information was included on the study aim and the study design. The importance of participation was emphasized. Further, it was mentioned that the study design included a 3-year follow-up period in which participants would be asked to fill out a total of 9 questionnaires. Anonymity and the voluntary nature of participation during the whole study period were also emphasized. Finally, it was explained what would be done with the data. Employees were asked to give their written informed consent for participation, which included the collection of their sickness absence data on the basis of organizational records. Employees with different jobs and educational levels, recruited from 45 companies and organisations that operate in all kinds of sectors were included to ensure contrast in exposure variables. Nearly 27,000 employees were approached for participation. To increase the response rate, a reminder in the form of a postcard was sent out two weeks after the mailing of the questionnaires (Dillman, 1978; Harvey, 1987). The overall baseline response rate was 45% (n=12,140).

Methods

Study design

The aim of the non-response analysis was to determine the presence of selective baseline response within the Maastricht cohort study. This was investigated by comparing those characteristics between respondents and non-respondents that were deemed important to the study objectives. Data on non-respondents were gathered in additional data collection. A sample of non-respondents was invited by postal mail to fill out a non-response questionnaire. The non-response questionnaire was brief (one page) and easy to fill out. A postage paid return envelope was enclosed. The non-response

questionnaire was sent back anonymously to the research group. The appeal that accompanied the non-response questionnaire included an excuse for contacting these people again and an explanation of the reason why some information on non-respondents was useful.

In the non-response questionnaire, variables were included that were expected to relate to fatigue and its course and that were easily measured. In order to be able to compare the respondent with the non-respondent data, questions were asked as much as possible in an identical way as in the baseline questionnaire.

Non-respondents were defined as potential cohort members who had not returned the baseline questionnaire at the time of six to eight weeks after the mailing. They also had not reacted to the reminder. From this population a subsample of non-respondents was drawn who were asked to fill out the non-response questionnaire. A total of 600 non-respondents were approached. To increase the diversity of employees and organizations in the random sample the three largest participating organizations were prevented from being overrepresented in the sample. This was done by fixing the number of included employees for these organizations.

Measures

At the top of the non-response questionnaire, the reason for non-response was asked. More than one non-response reason could be ticked, and an extra open category was added. The reason for non-response might be something that people want to get off their chest. It was expected that filling out this question would stimulate non-respondents to fill out the other items in the questionnaire, which were used to state the presence of a selection bias. Further, the reason for non-response might reveal information that can be taken into account in similar, future studies to maximize the response rate.

In addition to the reason for non-response, the non-response questionnaire contained some health related variables. A dichotomous item on the prevalence of fatigue complaints was included, as well as a question about the attribution of the fatigue complaints (i.e. 'mental', 'physical' or 'do not know'). There was no space to include the 20-item multidimensional fatigue scale that was used in the Maastricht cohort study and on the basis of which the prevalence of fatigue among respondents was stated at baseline. The other included health related variables were: a dichotomous item on difficulties in the work execution due to health complaints during the last four months, a dichotomous item on the prevalence of sickness absence in the last four months and a question on subjective general health (cf. Aaronson et al., 1998). Furthermore, the sociodemographic variables gender, education and age were measured plus the number of working hours per week. At the bottom of the questionnaire some space was left for comments.

Statistical analysis

To investigate the presence of a selection bias, the non-respondent sample was compared to the respondent group on the scores on the variables that were included in the non-response questionnaire. Dependent on the level of measurement, differences between the respondent and the non-respondent group were calculated using Mann-Whitney U tests or Chi-square tests. Furthermore, correlations (i.e. contingency coefficients) between the study variables were calculated for both groups in order to check on important interrelationships. Analyses were performed with SPSS statistical software, version 8.0 (SPSS Inc., 1998).

Results

In total 33% of the questionnaires were returned. Finally, it appeared that 29% was useful for analysis. The remaining 4% was excluded because these people promised that they would still return the baseline questionnaire or they reported having it returned already. Consequently, data were available on 168 non-respondents.

Main reason why people did not respond to the baseline questionnaire was that they had no time to fill it out (30%). In total 18% thought nothing would be done with the results of the study anyway and 15% was not interested in the study subject. Further, 10% was afraid of sensitive information being exposed to their employer. Finally, 10% had lost the baseline questionnaire, or they had forgotten about it. Other reasons were less frequently given and dissimilar.

Table 1 shows the results of the comparison of the respondent and the non-respondent group. No statistically significant differences were found in sociodemographic characteristics. However, respondents did report significantly more working hours per week than non-respondents: respondents worked more often more than 40 hours per week and less often part-time. Furthermore, significant differences between the two groups were found in the percentage of employees reporting fatigue complaints, difficulties in work execution and sickness absence. Respondents scored worse than non-respondents on these variables. Within the group that had experienced fatigue complaints in the last four months, no difference was found in attribution of fatigue complaints between the two groups. Finally, no differences were found regarding general health. A majority thought their general health was good or excellent.

The correlation structure between test variables did not differ between the respondent and the non-respondent group; interrelationships were about the same size. In both groups, rather strong correlations (i.e., contingency coefficients) were found between 'fatigue complaints' on the one hand and 'difficulties in work execution ($cc=.33$) and 'sickness absence' ($cc=.38$) on the other hand.

Table 1 Descriptives and results of univariate analyses on the differences between respondents and non-respondents.

	Test variable (%)	Respondents (n=12,140)	Non-respondents (n=168)	Statistics
Age	<=35	29.2	34.8	-1.43
	36-44	37.4	35.4	
	>=45	33.3	29.9	
Educational level ¹	low	33.1	40.0	-.87
	middle	32.4	31.9	
	high	34.4	28.1	
Gender	Men	73.1	70.1	.73
Fatigue complaints ²	yes	55.2	42.0	11.22*
Attribution ³	<i>Physical</i>	29.8	32.8	1.04
	<i>Mental</i>	38.5	37.5	
	<i>Physical and mental</i>	11.8	14.1	
	<i>Do not know</i>	19.8	15.6	
Difficulties in work execution due to health complaints ²	yes	25.4	16.5	6.90*
Sickness absence ²	yes	39.1	21.3	21.41*
General health	excellent	31.6	30.5	-.01
	good	53.6	56.1	
	moderate or bad	14.8	13.4	
Number of working hours	>40	20.1	11.7	-2.76*
	36-40	53.5	55.6	
	26-35	14.7	17.3	
	<26	11.7	15.4	

¹ low educational level includes primary, lower vocational or lower secondary education; medium educational level includes upper secondary or intermediate vocational; high education includes upper vocational or university.

² during the past four months

³ written in italic because this question is only answered by a subgroup that reported fatigue complaints in the last four months; the numbers of respondents and non-respondents were n=5843 and n=65 respectively

Discussion

With regard to the question whether a selection bias could be stated, respondents appeared to report more often recent fatigue complaints, more often recent difficulties in work execution due to health complaints and more often recent sickness absence. These results suggest lower well-being among respondents. In addition, respondents reported significantly more working hours per week than non-respondents. No differences were found in general health. Sociodemographic characteristics did not discriminate between respondents and non-respondents. This is not in line with the literature on mail survey

non-response behaviour. In a review on this subject, it was concluded that lower educated survey recipients are generally less inclined to respond (Green, 1996). Less clear evidence was found for gender and age (Green, 1996). In the present study, the reasons for non-response were non-specific. Further, non-respondents were not unanimously critical of any research characteristics or procedures.

The seriousness of the selection bias is evaluated in light of the study objectives of the Maastricht cohort study. Descriptive and explanatory research questions can be distinguished. The presence of a selection bias has direct negative consequences for the descriptive part. Because fatigued employees appeared slightly overrepresented in the respondent group, the prevalence rate of fatigue at work at baseline is likely to be overestimated. Problems in explanatory analyses do not arise when there is enough variation in scores on dependent and independent variables in the cohort at baseline. Table 1 shows that the distribution of scores on important study variables at baseline meets this requirement (see also Kant et al., 2003). In this way a sufficient amount of statistical power is ensured to draw some well-founded conclusions on the etiology and course of fatigue in the work environment (Kant et al., 2003). Nevertheless, selective loss-to-follow-up can still threaten the validity of study conclusions. Selective loss-to-follow-up is stated when drop-outs differ in a systematic way from the continuous participants on important study variables. However, because the follow-up drop-outs filled out at least the baseline questionnaire, at least some background information is available on this group.

It must be noted that the determination of the selection bias in the Maastricht cohort study was based on the assumption that the non-respondents who have returned the brief non-respondent questionnaire are representative of the total group of non-respondents in the Maastricht cohort study. The group of non-respondents that returned the non-response questionnaire amounted 33% of the total number of approached non-respondents. A telephone non-response interview might have had a stronger positive effect on cooperation of non-respondents but this study design was not possible because of privacy reasons. However, in spite of this limitation, the number of non-respondents that returned the brief questionnaire seemed high enough to draw a rough picture of the characteristics of non-respondents. Finally, the presence of baseline non-response bias is not often investigated probably because the data are in most cases not readily available. However, information on selective response and the consequences for the study objectives is very relevant in every survey study to be able to put the conclusions into perspective.

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Summary

Introduction

Fatigue is an important symptom of stress-related disorders such as burnout, neurasthenia and overstrain. In the Netherlands, the group of disability benefit recipients on mental grounds, consists for the biggest part of employees who are assessed work disabled due to these stress-related disorders. This information, in combination with the fact that about 1/3 of the total population of disability benefit recipients is assessed work disabled on mental grounds, stresses the urge to get insight into the natural course of fatigue at work and in the consequences of fatigue at work such as sickness absence. As yet, little is known on this subject. Further, little is known on the determinants of a decrease in fatigue at work. This is important to be able to intervene early in order to prevent more chronic complaints and negative consequences of fatigue. For example, it is not known whether work characteristics, which were found to play an important role in the etiology of fatigue, affect the natural course of fatigue as well.

Aims and research questions

The study of the natural course of fatigue at work aims to get insight into: a) the natural course of fatigue itself and the determinants of a decrease in fatigue; b) the relationship between fatigue and sickness absence; c) in the determinants of early return to work (RTW) after long-term sickness absence. On the basis of these research questions, it is aimed to increase knowledge on possible interventions.

The aims are specified in the following research questions:

- 1) Is there a relationship between positive changes in work characteristics on the one hand (i.e. decrease in job demands, an increase in decision latitude and an increase in social support) and a decrease in fatigue on the other hand? Is the effect of these positive changes on fatigue comparable to the effect of these changes on other well-known measures of mental health complaints such as work-related emotional exhaustion and psychological distress?
- 2) Are work characteristics predictive of a decrease in fatigue in *fatigued employees*? And: are these work characteristics predictive of fatigue in all of its dimensions (i.e. subjective fatigue, reduction in motivation, reduction in concentration and reduction in activity) or are these only predictive of specific fatigue dimensions?
- 3) Does fatigue predict sickness absence?
- 4) Are work characteristics predictive of early RTW after long-term sickness absence? Although this research question is not directly related to the study of the natural course of fatigue, it was necessary to investigate this relationship, considering the little knowledge on this relationship in the literature and in light of the appropriate analysis of the last research question. This is because work characteristics might confound the results of the last research question.

- 5) Does fatigue affect early RTW after long-term sickness absence? Considering that the role of fatigue might vary across diagnosis categories, the research question was investigated in the whole study population as well as within diagnosis categories (mental health complaints, musculoskeletal complaints, other physical complaints).

The first three research questions were investigated in an employee population that was initially still working and not (yet) on sickness absence. The fourth and fifth research questions were executed within a long-term sick-listed employee population. It can be derived from the above-stated that in the research questions, outcomes were chosen that represent different phases of the natural course of fatigue at work.

Study design

The project is part of the Maastricht cohort study. The cohort, which was followed for three years, included at the start of the study in 1998 more than 12,000 employees coming from 45 companies and institutions. Employees were sent every four months a mailed, self-administered questionnaire on work and health. Once a year this concerned an extensive version including among others questions on sociodemographics, work characteristics, fatigue and secondary health outcomes. Twice a year this concerned a short version including mainly fatigue and secondary health outcomes. To answer the third research question of this thesis, organizational absence records were obtained that were assessed at the company level by record linkages. To answer the fourth and fifth research questions of this thesis, data on early RTW were collected in a subsample of employees who were sick-listed for at least six weeks.

Results

Chapter 2 shows that employees who reported a decrease in job demands, an increase in decision latitude or an increase in social support simultaneously experienced a decrease in fatigue over the same period. The reported positive changes in work characteristics additionally went together with a decrease in work-related emotional exhaustion and psychological distress.

Chapter 3 reports on a study in a fatigued working population. It was determined that a decrease in job demands led to a future positive development in fatigue in all of its dimensions. Thus, a decrease in job demands led to a decrease in subjective fatigue and an increase in motivation, concentration and activity. An increase in decision authority only led to a future increase in motivation and not to a change in the other fatigue dimensions.

Chapter 4 shows that a higher score on fatigue increased the likelihood of short-term as well as long-term sickness absence.

Chapter 5 illustrates that a higher level of supervisor support was related to early RTW. Job demands and skill discretion had marginally significant effects on early RTW.

Chapter 6 shows that employees sick-listed due to mental health complaints had significantly higher fatigue scores than employees sick-listed due to musculoskeletal

complaints or other physical health complaints. Surprisingly, the relatively high fatigue scores did not obstruct early RTW. Within the group that was sick-listed due to musculoskeletal complaints and that had early returned to work with adjustments, it was stated that high fatigue obstructed early full RTW. As within the group of employees who were sick-listed due to mental health complaints, no effect of fatigue on early RTW was stated within the group sick-listed due to other physical health complaints.

Conclusions

First, it can be concluded that fatigue at work is a complaint that should be taken seriously. This conclusion is based on the fact that fatigue appeared to be a robust phenomenon. Moreover, a higher fatigue score went together with an increased risk of future short-term as well as long-term sickness absence.

Second, the present thesis shows that risk factors vary across the stages in the natural course of fatigue. This is illustrated by the fact that work characteristics, that appeared to play an important role in the etiology of fatigue, had a less pronounced role in the prediction of a decrease in fatigue in fatigued employees. Further, fatigue was found to predict sickness absence, but fatigue played a less pronounced role in the prediction of RTW after long-term sickness absence. These findings have consequences for interventions aimed at the prevention of chronic complaints, sickness absence and disability: while tailoring an intervention to an employee (i.e. choosing the contents of an intervention and deciding on the stress that is laid on certain aspects in the intervention), it should be taken into consideration in which stage of the natural course of fatigue this employee finds himself/herself in (not fatigued, fatigued but yet at work, long-term sick-listed). This might have positive consequences for the effectiveness and efficiency of interventions.

Third, it appeared that the factors that predicted early RTW, differed by diagnosis category. The contents and the stress that is laid on certain aspects in an intervention is thus also dependent on the nature of the health complaints due to which the employee is long-term sick-listed.

Samenvatting

Inleiding

Vermoeidheid is een belangrijk symptoom van stressgerelateerde aandoeningen zoals burnout, neurasthenie en overspanning. In Nederland bestaat de groep mensen die arbeidsongeschiktheid is verklaard op psychische gronden voor het grootste deel uit mensen die arbeidsongeschikt zijn verklaard vanwege stressgerelateerde aandoeningen. Aangezien ongeveer 1/3 van de totale populatie arbeidsongeschikten arbeidsongeschikt is verklaard om psychische redenen in Nederland, is het, gezien het voorgaande, belangrijk om meer inzicht te verkrijgen in het beloop van vermoeidheid op het werk en in de consequenties van deze vermoeidheid op het werk bijvoorbeeld in termen van verzuim. Hierover is tot nu toe weinig bekend. Tevens is weinig bekend over factoren die herstel van vermoeidheid op het werk bevorderen. Dit is belangrijk om vroeg te kunnen ingrijpen om chronische klachten en negatieve consequenties van vermoeidheid te voorkómen. Zo is bijvoorbeeld niet duidelijk of werkkenmerken, waarvan in eerder onderzoek is gebleken dat ze een belangrijke rol spelen in het ontstaan van vermoeidheid, ook herstel van vermoeidheid beïnvloeden.

Doelstellingen en vraagstellingen

Het onderzoek naar het beloop van vermoeidheid op het werk beoogt a) inzicht te krijgen in het beloop van de vermoeidheid zelf en de determinanten die dit beloop beïnvloeden; b) in de relatie tussen vermoeidheid en verzuim; en c) in de determinanten van vroegtijdige terugkeer op het werk na langdurig verzuim. Op basis van deze vraagstellingen wordt beoogd aanwijzingen te verkrijgen voor mogelijke interventies.

De hierboven genoemde doelstellingen zijn gespecificeerd in de volgende vraagstellingen:

- 1) Is er een relatie tussen positieve veranderingen in werkkenmerken (d.i. minder werkdruk, meer autonomie en meer steun op het werk) en een daling in de mate van de vermoeidheid? In hoeverre is het effect van deze positieve veranderingen op vermoeidheid vergelijkbaar met het effect hiervan op overige bekende maten van psychische gezondheidsklachten zoals werkgerelateerde emotionele uitputting en psychische klachten?
- 2) Hebben werkkenmerken effect op een daling in de mate van vermoeidheid *bij vermoeide werknemers*? Zo ja, hebben deze werkkenmerken effect op vermoeidheid in al zijn dimensies of uitsluitend op specifieke vermoeidheidsdimensies (subjectieve vermoeidheid, reductie in motivatie, reductie in concentratie en reductie in activiteit)?
- 3) Heeft vermoeidheid voorspellende waarde ten aanzien van verzuim?
- 4) Hebben werkkenmerken effect op vroegtijdige terugkeer in het werk na langdurig verzuim? Alhoewel deze onderzoeksvraag niet direct gerelateerd is aan de studie naar het beloop van vermoeidheid, was het onderzoeken van

deze relatie noodzakelijk, gezien de beperkte kennis in de literatuur over deze relatie en het feit dat deze relatie het inzicht in de laatste onderzoeksvraag bevordert.

- 5) Heeft vermoeidheid effect op vroegtijdige terugkeer in het werk na langdurig verzuim? Aangezien de rol van vermoeidheid kan verschillen per diagnose, is de vraagstelling zowel binnen de totale groep onderzocht als binnen diagnosecategorieën (psychisch, bewegingsapparaat en overige fysieke klachten).

De eerste drie vraagstellingen zijn uitgevoerd binnen een (in eerste instantie) werkende populatie. De vierde en vijfde vraagstelling daarentegen zijn uitgevoerd binnen een langdurig ziekgemelde populatie. Uit het bovenstaande kan worden afgeleid dat bij de uitwerking van de onderzoeksvragen gekozen is voor uitkomstmaten die verschillende fasen van het beloop van vermoeidheid op het werk representeren.

Opzet van het onderzoek

Het project maakt deel uit van de Maastrichtse cohortstudie. Het cohort omvatte aan het begin van de studie, in 1998, meer dan 12000 werknemers uit 45 bedrijven die gedurende drie jaar om de vier maanden gevolgd zijn middels schriftelijke vragenlijsten. Een keer per jaar kregen werknemers een uitgebreide vragenlijst thuisgestuurd met vragen over sociaaldemografische kenmerken, werk, vermoeidheid en secundaire, gezondheidsgerelateerde uitkomstmaten. Twee keer per jaar kregen werknemers een korte vragenlijst thuisgestuurd met hoofdzakelijk vragen over vermoeidheid en secundaire gezondheidsgerelateerde uitkomstmaten. Bij de beantwoording van de derde vraagstelling van dit proefschrift is gebruik gemaakt van ziekteverzuimdata die zijn verzameld op bedrijfsniveau. Tot slot zijn binnen de Maastrichtse cohortstudie interviews afgenomen met werknemers die tenminste zes weken waren ziekgemeld. Van deze laatste data is gebruik gemaakt om de vierde en vijfde vraagstelling te kunnen beantwoorden.

Resultaten

In **hoofdstuk 2** werd bij mensen die, over een jaar gemeten, een vermindering van de werkdruk, meer steun of meer sturingsmogelijkheden ervoeren, over dezelfde periode een daling in de mate van vermoeidheid gemeten. De genoemde veranderingen in de werkkenmerken hadden tevens een verlaging van werkgerelateerde emotionele uitputting en psychische klachten tot gevolg.

In **hoofdstuk 3** is gerapporteerd over een studie binnen een vermoeide werknemerspopulatie. Uit deze studie bleek dat minder werkdruk leidde tot een daling in de mate van vermoeidheid in al zijn dimensies. Een verhoging van de autonomie leidde tot een verandering in de score op slechts één enkele vermoeidheidsdimensie, namelijk tot meer motivatie.

In **hoofdstuk 4** bleek dat vermoeidheid zowel kort als langdurig verzuim tot gevolg heeft; de relatie was nog iets sterker voor langdurig verzuim.

In **hoofdstuk 5** bleek dat een hogere mate van steun van de leidinggevende een vroegtijdige terugkeer in het werk na langdurig verzuim bevorderde. Daarnaast hadden werkdruk en vaardigheidsmogelijkheden marginale effecten op vroegtijdige terugkeer.

In **hoofdstuk 6** bleek dat vermoeidheidsscores in de groep met psychische klachten veel hoger lagen dan in de overige diagnosegroepen. Opvallend was echter dat de verhoogde vermoeidheid binnen deze diagnosegroep vroegtijdige terugkeer in het werk niet belemmerde. Binnen de groep die verzuimde wegens klachten aan het bewegingsapparaat bleek hoge vermoeidheid een snelle, volledige terugkeer in het werk tegen te houden bij werknemers die in eerste instantie met aanpassingen hadden hervat. Binnen de groep met andere fysieke klachten dan bewegingsapparaatklachten werd, net als in de groep met psychische klachten, geen effect gevonden van vermoeidheid op vroegtijdige terugkeer in het werk.

Conclusies

In het algemeen blijkt uit het onderzoek dat vermoeidheid bij werknemers een klacht is die serieus genomen dient te worden. Dit bleek uit het feit dat vermoeidheid een hardnekkig fenomeen was. Dit bleek bovendien uit het feit dat naarmate werknemers meer vermoeid waren, zij in de nabije toekomst een grotere kans hadden op zowel kort als langdurig verzuim. Ten tweede wijst het onderzoek uit dat risicofactoren verschillen, afhankelijk van de fase in het beloop van vermoeidheid waarin de onderzoeksgroep zich bevindt. Zo bleken werkkenmerken, waarvan uit eerder onderzoek bekend is dat ze een grote rol spelen in het ontstaan van vermoeidheid, een kleinere rol te spelen in het beloop van vermoeidheid bij vermoeide werknemers. Bovendien werd gevonden dat vermoeidheid een sterke relatie had met het ontstaan van verzuim, maar dat er slechts in beperkte mate een relatie gevonden werd tussen vermoeidheid en vroegtijdige terugkeer in het werk na langdurig verzuim. Deze bevindingen hebben consequenties voor interventies die gericht zijn op preventie van chronische klachten, verzuim en arbeidsongeschiktheid: bij de keuze voor een interventie bij een werknemer dient waarschijnlijk meegewogen te worden in welk stadium van het beloop van vermoeidheid de werknemer zich bevindt (nog niet vermoeid, wel vermoeid maar nog steeds aan het werk, langdurig ziek). De inhoud van de interventie, of de nadruk die bij een interventie op bepaalde aspecten wordt gelegd, dient te verschillen per fase in het beloop van de vermoeidheid. Dit kan positieve gevolgen hebben voor de effectiviteit en doelmatigheid van interventies. Ten derde bleek uit het onderzoek dat de factoren, die vroegtijdige terugkeer in het werk bepaalden na langdurig verzuim, verschilden per diagnosecategorie. De inhoud van de interventie, of de nadruk die bij een interventie op bepaalde aspecten wordt gelegd, is dus tevens afhankelijk van de aard van de gezondheidsklachten die hebben geleid tot het verzuim.

Dankwoord

Niemand zal ontkennen dat het schrijven van een proefschrift gepaard gaat met een grillig vermoeidheidsbeloop. Dit geldt voor mij, maar ook voor anderen die me volgden in het proces en de perikelen rondom het proefschriftgebeuren meekregen.

Een speciaal woord van dank voor mijn promotor Prof. dr. Nijhuis. Frans, ik wil je bedanken voor je altijd aanwezige optimisme, je deskundige begeleiding en je steun. Als ik weer eens alleen de beperkingen van een stuk zag, gaf jij er een positieve draai aan. Als ik ergens een probleem van maakte, wist jij het probleem moeiteloos te relativeren. Brigitte, jij ook heel erg bedankt voor je steun, je eindeloze vertrouwen in me en de kansen die je me biedt. Voor zover ze dat nog niet waren, is inmiddels de hele familie Nijhuis bekend met het wel en wee van het schrijven van een proefschrift. Ghislaine en Wibke, bedankt voor jullie interesse! En Jules, jij bedankt voor de afleiding!

Mijn projectgroep, bestaande uit mijn eerste begeleider Frans Nijhuis en daarnaast IJmert Kant, Peter Janssen en Kees Schröer, bedank ik voor hun nuttige en zorgvuldige commentaar op mijn artikelen. De beoordelingscommissie (Prof. dr. Maarse, Prof. dr. Van Dijk, Prof. dr. Van Eijk, Prof. dr. Metsemakers, Prof. dr. Schaufeli) bedank ik voor hun beoordeling van dit proefschrift.

Mijn ex-collega's van de capaciteitsgroep BEOZ die ik nog niet heb genoemd en met name (in willekeurige volgorde) Maria T., Maria D., Gladys, Silvia, Pieter, Mariëtte, Catelijne, Sandy, Regien, Isel, Inge, Astrid, Ad, Angelique, Aggie, Hilde, Brigitte vd Z: heel erg bedankt voor jullie steun in de afgelopen jaren en de mogelijkheid die jullie me boden af en toe mijn hart te luchten.

Een woord van dank voor Prof. dr. Groot en Jan van Emmerik (en mijn (ex)kamergenootjes!!!), aangezien ik lange tijd, ook na het aflopen van mijn contract bij BEOZ, nog letterlijk dag en nacht terecht kon om te werken en natuurlijk om bij te kletsen met mijn ex-collega's.

Ik wil Prof. dr. Van den Heuvel bedanken voor de tijd die hij me gaf op het iRv om mijn proefschrift af te maken naast mijn gewone werk. Al mijn collega's op het iRv wil ik bedanken voor hun interesse in het proefschriftgebeuren en de inspirerende werkomgeving die ze creëren. En Imke, dank je voor je betrokkenheid en de gezelligheid!

Iedereen die heeft meegewerkt aan de dataverzameling van de Maastrichtse cohort studie wil ik bedanken. Daartoe behoren o.a. de PVA-aio's, Jos, Helma en de mensen van het Memic. Ik ben de laatste in het rijtje van de Maastrichtse PVA-aio's die gaat promoveren. Helene, bedankt voor de lol zowel in het verleden als in de toekomst! Laten we snel afspreken om elkaars nieuwe woonst te bekijken en flink bij te kletsen! Nicole,

bedankt voor de leuke uitjes tot nu toe en die nog zullen volgen! Danielle, bedankt voor de gezelligheid! De werknemers die de vragenlijsten steeds maar weer hebben ingevuld, en de langdurig ziekgemelde werknemers waarbij interviews zijn afgenomen, ben ik zeer erkentelijk voor hun medewerking. Dat geldt ook voor de contactpersonen van de 45 bedrijven die hebben meegedaan aan de Maastrichtse cohort studie.

Een speciaal woord van dank voor mijn ouders en mijn zus Müriel, die me gedurende de rit onvoorwaardelijk hebben gesteund. Bedankt voor jullie geduld met mij; ik hoop dat jullie trots zijn op het resultaat!

Marco, bedankt dat je me op weg wilde helpen met de omslag van dit proefschrift. Bianca, bedankt voor het vakkundig en snel lay-outen van het proefschrift.

Tot slot wil ik nog een aantal vrienden noemen die me enorm hebben geholpen de afgelopen jaren, ook indirect met het realiseren van dit proefschrift, door altijd voor me klaar te staan. Biek, ik geloof dat ik nooit op het idee was gekomen een promotietraject in te gaan als jij me niet was voorgegaan! Jörgen, bedankt voor je interesse en je steun tijdens de afgelopen jaren! Ondanks een aantal fikse tegenslagen in het afgelopen jaar kon je het steeds opbrengen om betrokken te blijven bij mijn wel en wee.

Lieve Daan en Alette, we kennen elkaar nu al zo lang: heel erg bedankt voor ALLES! Jullie steun en vriendschap betekent veel voor me. De afgelopen jaren zorgden jullie onder andere voor de nodige ontspanning door me steeds maar weer te (proberen te) betrekken bij leuke uitjes.

Daan en Silvia, ik ben er heel erg blij mee dat jullie achter me staan als ik het proefschrift verdedig. Jullie stralen rust en vertrouwen uit. Dat heb ik de afgelopen jaren erg gewaardeerd, en die rust en dat vertrouwen komen zeker ook goed van pas op het moment van de verdediging!

Allemaal heel erg bedankt!!!

Nathalie

Maastricht, april 2004

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Nathalie Janssen was born on August 5, 1974 in Eindhoven. She studied Personnel Sciences at Tilburg University (The Netherlands). After her graduation, she started working as a PhD student at the Department of Health Organization, Policy and Economics at Maastricht University in 1998. While working on her PhD, she educated students on the subject of Work and Health. During this period she also worked as a researcher on a project on gender differences in return to work after long-term sickness absence. Since 2002, the author is working as a researcher at the Institute for Rehabilitation Research where she is and has been involved in several research projects.